INTERNATIONAL ABSTRACTS OF SURGERY

VOLUME 85 NOVEMBER, 1947 NUMBER 5

COLLECTIVE REVIEW

THE CAUSES AND TREATMENT OF SCIATIC PAIN

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"Observational inquiry in . . . . . clinical medicine may give results that are questionable on the one hand because too much value has been given to conclusions essentially based on intuition, and on the other hand because the possibilities of exact observation and record have been exaggerated. We are all familiar with instances of large and imposing masses of records vitiated at their very base by the preconceptions of their compilers, or by the impossibility of precise records, and with instances of the hieratic pronouncement that rises superior to the need for proof." Wilfred Trotter.

"The development of a special sense is often followed by the atrophy of common sense." Arbuthnot Lane.

"It is necessary not only to find the cause of the patient's disability and to remove it, but also to convince him that he has been relieved and that he is able to return to his work." J. Grafton Love and Maurice Walsh writing on "Protruded Intervertebral Discs."

THE prolapsed intervertebral disc is now regarded by many authorities as the commonest, if not the only, cause of sciatic pain. This is a view which has gained wide support during the War. It is probable that during the war years there has been an absolute increase in the frequency of prolapsed discs, because large numbers of young men have been removed from their normal environment and subjected to abnormal strains for which many of them were unfitted. At the same time these cases have been segregated in "centers" where large masses of records have been compiled. These are necessarily the records of highly selected series, and they tend naturally to exaggerate the relative importance of the prolapsed disc.

It is, of course, true that when sciatica is accompanied by abnormal neurological signs the clinical aspect is that of a lesion at the root level, of which a prolapsed disc is a very likely cause. But even in such cases, actual observation shows that the prolapsed disc does not account for all cases; every surgeon familiar with this problem knows that in some of them the discs are found to be normal at operation.

The other group (it is numerically important), in which there are no abnormal neurological signs, contains cases in which the pain is referred. For these, there are several possibilities in diagnosis. The prolapsed disc is not the only factor.

It is proposed in this article to review the nature and causes of sciatic pain, and to recount the results obtained with various methods of treatment in a series of 298 cases.

TABLE I.—298 CASES OF SCIATIC PAIN

Military	104	Not selected
Civilian	145	
Operative	49	
Total	298	

THE NATURE OF SCIATIC PAIN

A. There is an important element of referred pain in most cases of sciatica.

Thus, we find that sciatic pain can nearly always be abolished by a *local subcutaneous* injection of novocain over the painful area.

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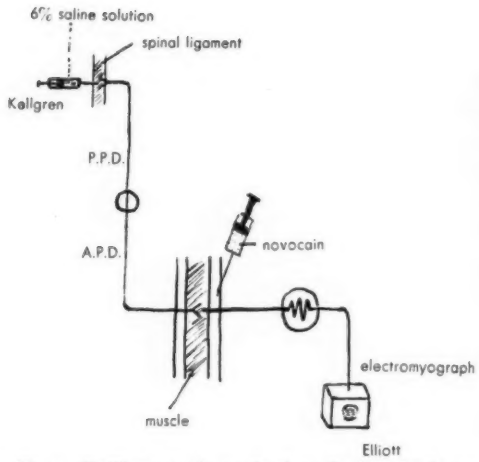

Fig. 1. To illustrate the mechanism of referred pain, as demonstrated in Kellgren's and Elliott's experiments. P.P.D. = posterior primary division. A.P.D. = anterior primary division.

Further, in cases of sciatica we constantly find a tender area over the sciatic notch. Local subcutaneous injection of novocain at this tender area abolishes the tenderness, and, more surprising, it causes Lasègue's sign to disappear, or to become much less marked.

When Kellgren's experiment, stimulating the spinal ligaments with 6 per cent saline solution (Fig. 1) is repeated, we find that the injection always causes local backache at the site of injection. It sometimes causes, in addition, a referred pain in the leg. This pain is not referred, as Kellgren believed, on a segmental basis. It is inconstant in distribution, in the nature of a dull aching discomfort, and poorly localized. The patient has difficulty in saying exactly where it is. The pain is, in fact, very similar to that in many cases of sciatica. It is immediately relieved by a subcutaneous injection of novocain over the painful area. And, of course, an injection of novocain into the spinal area which was stimulated will immediately abolish both the local backache and the referred pain.

It will be remembered that Elliott investigated sciatica of various types, including several cases of proved prolapsed disc. Using the electromyograph, he showed that in sciatica of all types the pain is associated with muscle spasm in the painful area. He then repeated Kellgren's experiment, producing referred sciatic pain artificially by chemical stimulation of the spinal ligaments with 6 per cent saline solution. This pain also was shown by the electromyograph to be associated with muscle spasm.

Elliott considers that muscle spasm may be responsible in cases of sciatica for a considerable part of the patient's total discomfort. The spasm may be produced either by direct irritation of a nerve root, as in the cases he investigated in which a prolapsed disc was subsequently found at operation, or by a stimulus which arises outside the nerve roots, through a reflex path involving the anterior horn cells. In the latter case, referred sciatic pain is produced by stimulation of those posterior primary divisions whose corresponding anterior primary divisions form the sciatic system (Fig. 1). The experimental demonstration of this by Kellgren's method of chemical stimulation has already been mentioned. The clinical application depends upon the anatomical distribution of the nerves concerned.

The anterior primary divisions of the fourth and fifth lumbar nerves and the first, second, and third sacral nerves take part in the formation of the sciatic nerve. The spinal musculature, the intervertebral joints, the posterior common ligament of the spine, the ligamentum flavum, and the interspinous and supraspinous ligaments are innervated by the posterior primary divisions of the same nerves and by recurrent twigs (nervus sinu vertebralis, Luschka) formed of branches from the spinal nerves and from the sympathetic chain, which turn back into the spinal canal through the intervertebral foramina. Stimuli originating in these spinal structures may cause pain which is referred to areas supplied by the anterior primary divisions of the spinal nerves concerned.

Cases of referred pain are numerically important. In our series of 249 consecutive cases, there were 129 (52%) of the referred type without neurological signs.

B. So far as direct sciatic pain is concerned, it is obvious clinically, in many cases, that the nerve is affected at a root level. In this connection the anatomical relations of the roots are important.

The nerve roots leave the canal via the intervertebral foramina. The foramina are pear shaped, with the narrow end downward (Fig. 2) and the roots lie in the narrow inferior parts of the foramina. (Fig. 3.) In the lumbar region the foramina become progressively smaller as the spine is descended. The nerve roots, however, become larger, and so the lower lumbar nerve roots, which are the thickest, lie in the smallest lumbar foramina (Danforth and Wilson) and, what is more, in the narrow inferior parts of these apertures, to which they are anchored by thin bands of fibrous tissue, which sometimes are shown by dissection (Fig. 7.)

Fig. 2.

Fig. 2. Model to show intervertebral foramina. Note particularly the lateral extension of the ligament flavum, and its attachment to the capsule of the lateral joint. The foramina are pear shaped.

Fig. 3.

Fig. 3. Nerve root in narrow inferior part of foramen, closely related to disc, lateral joint, and ligamentum flavum.

Fig. 4.

Fig. 4. Model showing attachment of ligamentum flavum to lamina and articular process.

As they run obliquely downward and outward through the foramina, the nerve roots are related:

1. Anteriorly to the intervertebral disc and to the margins of the vertebral bodies above and below. Note that the anterior wall of that narrow inferior part of the foramen in which the nerve root lies is formed principally by the disc. The relation between disc and root is intimate.

2. Posteriorly to the ligamentum flavum, to the capsule of the lateral joint, and to the antero-lateral surface of the lower articular facet.

The ligamentum flavum is normally from 2 to 3 mm. thick. It is attached below to the upper margin of the lamina of the lower vertebra and extends laterally to a variable extent as a continuous sheet attached to the anterior and upper borders of the upper articular facet of this vertebra, and to the capsule of the intervertebral joint (Fig. 4). Above, the ligamentum flavum is attached to the anterior surface of the lamina of the upper vertebra and to the anterior surface of the root of the lower articular process of this vertebra, across which it extends laterally to a variable extent toward the root of the transverse process. There is a free lateral border which forms the posterior boundary of the outer mouth of the intervertebral foramen. This lateral border is closely related to the issuing nerve root (Fig. 5).

Each foramen transmits a spinal nerve, sympathetic filaments, blood vessels, and lymphatics. The space is normally adequate to contain these structures and their surrounding fat, but there is little room to spare and minor pathological changes in the walls of the foramen may suffice to cause pain.

Emerging from the foramina, the nerves divide into the anterior and posterior primary divisions and the fourth anterior primary division turns downward in front of the transverse process of the

Fig. 5. Dissection of lumbar spine viewed from the side. The fourth and fifth transverse processes have been removed. The third, fourth, and fifth nerves are seen emerging from the foramina. At each foramen the lateral edge of the ligamentum flavum is clearly seen, in contact with the issuing root, forming the posterior boundary of the intervertebral foramen.

fifth lumbar vertebra to form, with the corresponding division of the fifth nerve, the lumbosacral trunk. In this part of their course the nerve roots are related to the medial border of the psoas muscle. The lumbosacral trunk passes in front of the lateral mass of the sacrum. It finally descends in front of the lower part of the sacroiliac joint to form, with the anterior primary divisions of the upper three sacral nerves, the sacral plexus overlying the pyriformis muscle.

These anatomical and physiological considerations show that, in theory at any rate, the causes of sciatica are numerous. They may conveniently be classified in the following list, which is a rearrangement of that suggested by Professor Platt:

1. "Pseudosciatica," caused by fibrositis of the muscular, fascial, and ligamentous tissues of the lower back, buttocks, and thighs.
2. Joint lesions, in the lumbar spine and sacroiliac joints. (The joints of the lumbar spine are the intervertebral discs and the lateral articulations).
3. Tumors of the central nervous system.
4. Pelvic tumors.
5. Bony lesions, e.g., inflammatory or neoplastic disease of the lumbar vertebrae, pelvic bones, or femora.
6. Sciatic neuritis.
7. Functional disorders.

Tumors of the central nervous system, pelvic tumors, and bony lesions are very rarely the cause of sciatica. In our series there was only 1 case of tumor of the central nervous system, and none was attributable to pelvic tumor or bony disease.

Fibrositis is a common cause of sciatic pain. The pain is badly localized, of the referred type, unaccompanied by any abnormal neurological signs, and associated with pain and tenderness in the lower back, roentgenograms of which are normal. The pain is referred from the lower back, through the posterior primary divisions, by the mechanism we have already described.

The nature of the lesion in the lower back is usually difficult to prove. Fibrositis has been described as a low grade inflammatory process, affecting the supporting fibrous tissue of the part, with serofibrinous exudate, proliferation of fibroblasts, and localized tissue thickenings or "nodules." Cultures of the exudate are sterile. Cold, trauma, focal infection, general infections (influenza), and disorders of the metabolism are believed to play a part in the pathogenesis of fibrositis (Stockman, Slocumb). The intermuscular fascial spaces (intermuscular planes), where these inflammatory changes occur, are believed by some to be lined by a layer of flattened endothelium. After air insufflation, the outline of these spaces can be demonstrated with x-rays, and their deformation by adhesions has been described (Gratz). Wagner and Maws report cases in which adhesions around the sciatic nerve in the thigh have been exposed at operation. They describe bands of fibrous tissue constricting the nerve at the level of the gluteal fold, at the bifurcation of the nerve, and at the upper limit of the popliteal space. Relief of sciatic pain followed division of the fibrous bands.

Herniation of fat has been described by Copeman and Ackerman and Herz as a cause of fibrositic pain.

In our consecutive series of 249 cases there were 137 (55%) with no abnormal neurological signs. Of these 94 (36% of the total) were diagnosed as being due to fibrositis.

Joint lesions. These include lesions of the intervertebral discs and ligamenta flava, the lateral joints of the spine, and also some congenital anomalies in the lumbar region (sacralization of the fifth lumbar vertebra and spondylolisthesis).

A degenerate disc may protrude sufficiently to cause pressure upon a nerve root or roots, and thereby cause pain and (usually) abnormal neurological signs indicating interference with conduction in the nerve root or roots concerned. A large central protrusion may affect several roots of the cauda equina. A protrusion near the midline will affect the root corresponding to the segment below the protrusion. A lateral protrusion will affect the nerve root corresponding to its own segmental level.

It is, however, most important to realize that in a large proportion of the disc lesions there is no question of pressure on the nerve roots. In these cases, the pain is of the referred type, and there are no abnormal neurological signs. At operation a degenerate disc, of soft and irregular consistency, is found, but there is either no protrusion at all, or only a very slight one, obviously insufficient to affect a nerve root by pressure. Approximately one-half of the abnormal discs which I have exposed have been of this type.

The close relation between the lateral part of the ligamentum flavum and the issuing nerve root has already been described. The lateral edge of the ligament forms the posterior boundary of the exit from the foramen and here lies in actual contact with the nerve root (Fig. 5). Hypertrophy of the ligamentum flavum may produce direct pressure on the nerve root. Elsberg was the first to report a case of this type. It followed injury. Towne and Reichert reported 2 cases, in one of which bone had formed in the thickened ligament.

Fig. 6.

Fig. 7.

Fig. 6. Dissection of lumbar spine viewed from behind. The laminae and the superficial articular facets have been removed. The nerve roots are closely related to the lateral joints. This is well shown, particularly on the right side in the case of the fourth and fifth roots.

Fig. 7. Dissection of lumbar spine and nerve roots. The vertebral bodies have been removed and the specimen is viewed from the front. The third lumbar root on the left side is lifted with forceps and dense adhesions are clearly seen attaching this root to the floor of the intervertebral foramen.

Apart from this, the microscopical appearances were those of a normal ligamentum flavum, i.e., the process appeared to be a simple hypertrophy. Spurling, Mayfield, and Rogers reported 7 cases in which the ligament was thickened between the fourth and fifth lumbar vertebrae. On section there was more white fibrous than elastic tissue; there were areas of calcification, and in 2 cases old blood pigment was found. It seemed probable that trauma was the cause of the hypertrophy. Brown reported 6 cases with thickening of the ligamentum flavum, in which the elastic tissue had been partly replaced by fibrous tissue. The degree of thickening in these various cases ranged from 8 to 16 mm. (normal 2 to 4 mm.). In every case the thickened ligament was causing pressure on a nerve root, or roots.

In several of our own cases a thickened ligamentum flavum causing pressure on a nerve root was found at operation. In some cases the hypertrophy was the only abnormality; in others there was an associated prolapse of a disc at the same interspace. Section of the thickened ligament showed a normal structure in some cases; in others there was abnormal white fibrous tissue formation in the ligament.

The role of the lateral intervertebral joints in the production of sciatica is controversial.

The anatomical disposition of the joints is variable. The facets in the upper part of the lumbar spine are "normally" in the sagittal plane, but the lumbosacral facets are "normally" in the coronal plane. Putti (72, 73) remarked on the frequency of variations from the "normal" arrangement, and in particular on asymmetrical variations. Brailsford showed that in 3,000 spines, the lumbosacral facets were disposed coronally in 57 per cent, sagittally in 12 per cent, and obliquely and asymmetrically in 31 per cent.

Putti (72, 73) stated that anomalous facets of peculiar shape and disposition may reduce the size of the intervertebral foramen, and so mechanically embarrass the nerve root. He believed also that anomalies, and particularly asymmetrical anomalies, of the articular facets, cause abnormal articular wear and tear, culminating in a mechan-

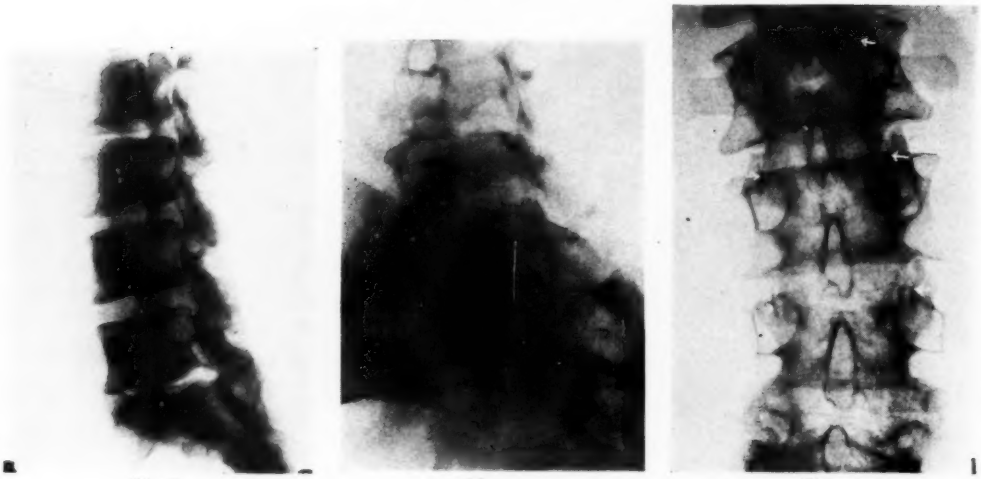

Fig. 8. Fig. 9. Fig. 10.

Fig. 8. Oblique view of lateral joints. (Normal)
Fig. 9. Oblique view to show arthritic change in lumbosacral lateral joint.

Fig. 10. Roentgenogram showing arthritis of lateral joints in ankylosing spondylitis. (Film lent by Dr. Campbell Golding).

ical arthritis, frequently demonstrable in good roentgenograms. This arthritis might influence the adjacent nerve root, either by swelling of the joint itself or by an associated periarticular edema and engorgement. And clearly an arthritic lateral joint (innervated by the posterior primary division of a spinal nerve) might be a source of referred pain. Putti interpreted the stiffness of the spine, so often associated with sciatica, as a clinical sign of spinal arthritis. Lateral deviations of the spine, sciatic scoliosis, he also regarded as a product of spinal arthritis.

Bankart agrees with these views of Putti, but there are not many other supporters. In fact, the idea has been dismissed in a summary fashion by some writers (Hurst). The available evidence concerning the theory is given herewith.

We have already pointed out how close is the relation between the lateral joints and the nerve roots. As the root enters the intervertebral canal it lies actually in contact with the capsule of the corresponding lateral joint (Fig. 6).

In some specimens which we dissected, osteoarthritic changes had occurred in the lateral joints, and were associated with remarkable changes around the nerve roots. Adhesions of varying density had formed around the nerve roots in the intervertebral foramina (Fig. 7). In one specimen there was also a dense fibrosis around the nerve roots, outside the intervertebral formina, where they lie on the lateral aspect of the vertebral bodies, at the roots of the transverse processes. Here they were surrounded by dense fibrous tissue, and could be separated from the bone only by sharp dissection. The fibrous network was intimately connected with the adjacent muscles. Putti and Logroscino made similar observations. In many specimens they found arthritic changes in the joints with ulceration and fibrillation of the articular cartilage, hypertrophic synovial villi, loose bodies, capsular edema, and adhesions between the joint capsule and the meningeal covering of the adjacent nerve roots. In some cases arthritic changes which could not be detected radiologically were found on dissection. From these investigations Putti concluded that arthritic changes are present in the lateral intervertebral joints of most people more than 40 years of age.

Unfortunately, it is more difficult to demonstrate arthritic changes in the lateral joints of the living subject. The clinical signs, stiffness of the spine and pain on forced movements, are obvious; but these signs may also be produced by other lesions, for instance by degeneration of the intervertebral discs. Roentgenography, the obvious "court of appeal," is useless unless the films are absolutely "first class," a standard not always attained in routine work. Thus, we examined the roentgenograms of the 298 cases which are considered in this article, but the results were not worth reporting so far as the lateral joints were

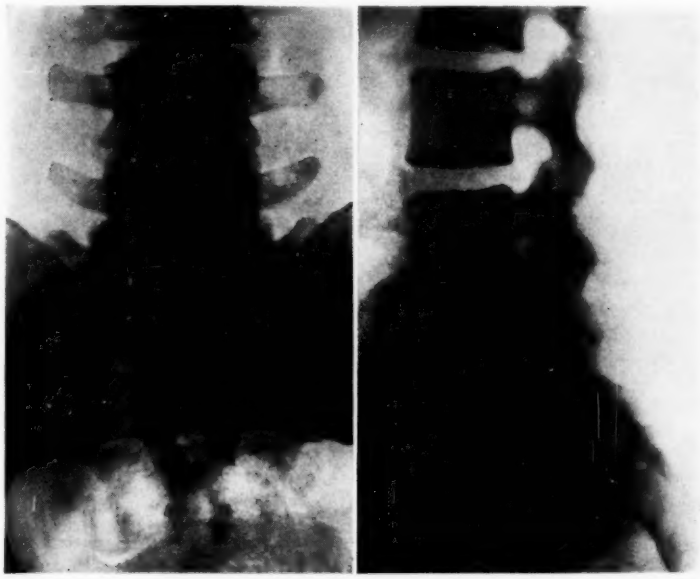

Fig. 11. A case of bilateral sacralization of the fifth lumbar vertebra. In the lateral view marked congenital narrowing of the fifth lumbar disc is seen. There is, in addition, acquired narrowing of the fourth disc with slight posterior displacement of the fourth lumbar body and osteophyte formation on the posterior lower edge of this.

concerned, because in many of the films these joints were not clearly shown.

What then is the position of spinal arthritis considered as a cause of sciatica?

1. Arthritis of the lateral joints does occur, and is probably common.

2. For technical reasons it is difficult to demonstrate arthritis of the lateral joints.

3. On anatomical and physiological grounds, it appears that arthritis of these joints may cause sciatica, either as a referred pain, or because of associated periradicular changes. It is an explanation which may reasonably be considered when the clinical picture is that of a lesion at root level but the discs are found to be normal at operation.

In our consecutive series of 249 cases, spinal arthritis was considered to be the responsible factor in 41 cases (17%).

In connection with lateral joint arthritis, the association of sciatica with ankylosing spondylitis is interesting. This disease sometimes presents itself as sciatica. Golding recorded 98 cases, of which 14 (11%) had at first been diagnosed as sciatica. In our series of 298 cases there were 4 in which the sciatic pain was a symptom of ankylosing spondylitis. In all 4 cases the pain was of the referred type—there were no abnormal neurological signs. It seems likely that in such cases the sciatic pain is caused by the lateral joint arthritis which occurs in ankylosing spondylitis (Fig. 10).

Sacralization of the fifth lumbar vertebra occurs frequently as a congenital anomaly, and does, of course, materially alter the circumstances in which the fifth lumbar root leaves the spine, but since the nerves and the vertebral column develop *pari passu*, it seems improbable that the enlarged transverse process, as such, would affect the function of the fifth root. Secondary pathological changes may possibly do so. Thus, the joint between an enlarged fifth transverse process and the lateral mass of the sacrum may become arthritic and so affect the contiguous nerve root. If the sacralization is unilateral, it seems likely that abnormal strain may be thrown upon the lower lateral joints on the opposite side, predisposing them toward arthritic change. The most important result of sacralization, however, is the altered status of the *fourth* lumbar disc. Sacralization fixes the fifth lumbar segment. It follows that the maximum strain, which normally falls upon this

segment, as the lowest point of the mobile spinal column, must now be taken by the fourth lumbar disc. Hence, there is in these cases a tendency toward degeneration of the fourth disc. This has been noted by Capener. The patient whose roentgenograms are shown in Figure 11 is a case in point. There is bilateral sacralization of the fifth lumbar vertebra, with congenital narrowing of the lumbosacral disc. There is also acquired narrowing of the fourth lumbar disc, with osteophyte formation at the lower posterior angle of the fourth lumbar vertebra.

Acquired narrowing of an intervertebral disc may be distinguished from congenital narrowing by the associated sclerosis of the adjacent bone margins and by osteophyte formation at their edges. The pathology of disc degeneration with subsequent narrowing causing arthritic changes in the spine has been studied by Keyes and Compere. A narrow disc affects the size of the corresponding intervertebral foramina (Hadley). Subluxation of the lateral joints occurs with upward displacement of the lower articular facets and slight backward displacement of the upper vertebral body in relation to the lower (Fig. 11.) Both these factors decrease the size of the foramen, and the combined effect may be significant, especially in the case of the lumbosacral junction, where the smallest foramen of the lumbar series transmits the largest lumbar root.

Meyerding (62, 63) quotes a series of 745 patients with spondylolisthesis of whom 10.7 per cent had coincident sciatica; nearly all of these patients had either grade I or grade II spondylolisthesis. There is, of course, a possibility of pressure by the posterior edge of the lower vertebra, and, in addition, spondylolisthesis increases the risk of protrusion of a disc.

Our series includes one case of spondylolisthesis, but laminectomy revealed no prolapse.

Lesions of the sacroiliac joints are not often the cause of sciatica. Sciatica of a referred type, without neurological signs, is occasionally associated with sacroiliac strain, and both are relieved by manipulation. Porter mentions 3 cases of sacroiliac tuberculosis in which sciatic pain was present. I have never seen osteoarthritis of the hip joint as a cause of sciatica, although it is often described as such.

Sciatic neuritis. Does true sciatic neuritis occur? Biopsy and postmortem reports are unfortunately scanty. Hunt recorded a series of cases in which the sciatic nerve was thickened and edematous, and on section showed vascular engorgement and inflammatory exudate between the perineurium and the endoneurium. The changes were not marked. Denny Brown reports the case of a woman with disseminated sclerosis, who developed sciatica. She collapsed and died while having an oxygen injection around the nerve. At autopsy the sciatic nerve on the right side was swollen over the whole of its course from the sciatic notch to the popliteal region and the blood vessels were noticeably engorged. There were no signs of "adhesions" or other fibrous tissue changes. A small piece of the nerve was made available by the Coroner for section. Nothing abnormal was seen in the low power view. Under high power it was seen that the vessels were engorged and there was lymphocytic infiltration around some small venules. The perineurium around some of the nerve fibers was lifted up by an exudate. The nerve fibers themselves appeared to be intact.

This is the pathology of acute interstitial neuritis. It would produce severe pain and marked tenderness over the course of the nerve with fasciculation and wasting. Although this type of case is seldom seen in surgical practice it is fully described by physicians (Walshe, Cohen) and is referred to as "true sciatica." Complete recovery after a few weeks of conservative treatment is not uncommon. Cohen points out that true sciatica sometimes presents the characteristics of a febrile illness, having a sudden onset, with a raised temperature during the first few days.

The functional element in sciatica. A functional element is present in many cases of sciatica. The purely functional cases and the malingerer are rare. However, many patients who have true sciatica with an organic basis develop, for one reason or another, a functional "overlay" which makes the pain worse, obscures the diagnosis, makes the condition persist, and impairs the chance of successful treatment.

CLINICAL EXAMINATION

The diagnostic possibilities thus briefly reviewed must be considered in the light of a careful clinical examination, which may be conveniently carried out on the following plan:

History
Lumbar spine—shape, mobility, and tenderness in the back and the lower limb; trigger points
Lasègue's sign
Wasting
Motor power
Tendon reflexes
X-ray examination
Rectal examination
Focal sepsis
W.R.

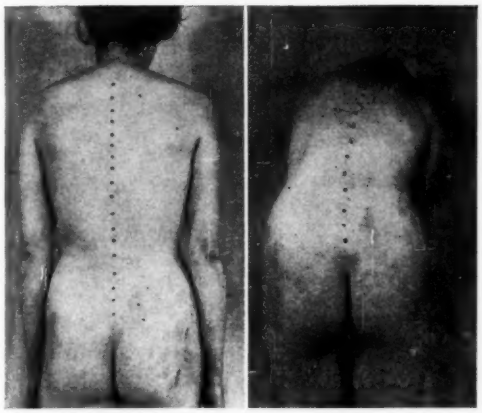

Fig. 12. Right sided sciatica. On bending forward the spine deviates toward the painful side. At operation a "concealed disc" (lumbosacral) was found.

Urine
Lumbar puncture

History. Pain in the back, described by the patient as lumbago, is almost invariable. It may precede or be coincident with the sciatic pain. The backache may be fibrositic in origin, it may be caused by degenerative changes in, or injury to, an intervertebral disc, or it may be associated with spinal arthritis.

The prevalence of injury as a causative or precipitating factor has been stressed too much in recent literature. Only a relatively small proportion (13%) of proved cases of prolapsed disc in our series had a history of injury definite enough to be held responsible. It seems probable that injury may precipitate the prolapse of an already degenerate disc; but only a *very* severe injury could possibly cause prolapse of a normal disc. Friberg has shown experimentally that the normal intervertebral disc is capable of withstanding, without damage, very severe strain. In a fresh cadaver, he punched a hole in the annulus of a lumbar disc. No prolapse occurred, nor did any appear after repeated violent movements of the spine or after great axial pressure. Moreover, when the cut was deepened to the nucleus itself and a prolapse had appeared, its size was not affected, or only very slightly, by movements of the vertebrae.

The influence of trauma in the production of prolapsed disc is, of course, an important medico-legal point. Trauma can be only a precipitating factor, i.e., an injury can cause a prolapse only if the disc is already degenerate.

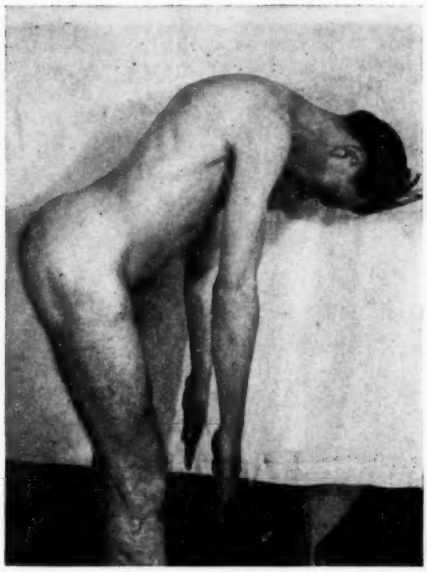

Fig. 13. Fixed lumbar lordosis associated with right sided sciatica and spinal arthritis.

On the other hand, there appears quite often to be a definite connection between exposure to adverse climatic conditions and the onset of lumbago and sciatica. Sleeping out on wet ground, working in the rain and cold, or sitting on wet or cold surfaces, often precipitates the first attack, presumably of a fibrositic type.

Coughing, sneezing, heavy lifting, and straining of any sort usually cause exacerbation of the sciatic pain, whatever the cause of the latter may be. No special diagnostic significance, indicating a prolapsed disc, should be attached to this symptom.

The state of the sphincters should be determined by careful questioning. Loss of control may indicate an intraspinal lesion.

The history of the previous attacks and their duration may help in the prognosis and may be a guide to treatment.

The lumbar spine. The back should be examined with regard to shape, mobility, and tenderness. The range of movement of the lumbar spine is tested systematically. Some limitation is nearly always observed, ranging from slight stiffness to absolute rigidity. Extension is tested by making the patient lean backward from the erect position; flexion, by bending forward in an attempt to touch his toes with the knees straight. The latter move-

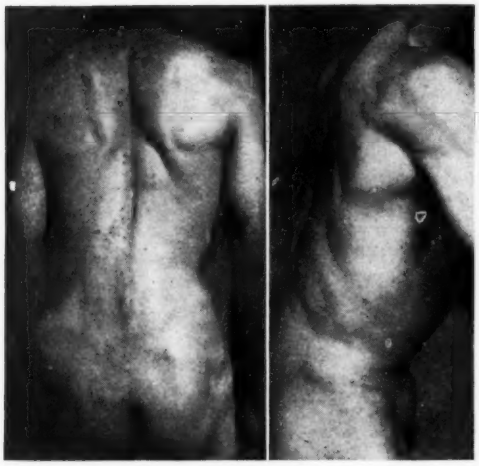

Fig. 14. A typical disc spine with left sciatica. There is lumbar kyphosis and a slight spinal list to the right. The spine is almost rigid. At operation a "concealed" disc (lumbosacral) was found.

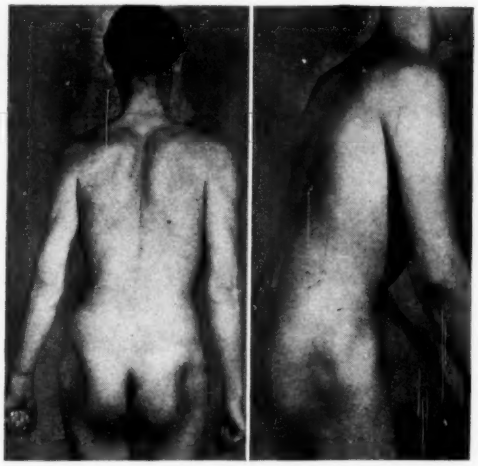

Fig. 15. A typical disc spine with left sided sciatica. Note spinal list to the right. The spine is almost rigid. The scar of an unsuccessful Ober's operation is seen. On laminectomy a degenerate lumbosacral disc was found.

ment may be limited, either by a true stiffness of the spine, or by a painful spasm of the hamstrings. To differentiate between the two, the movement of flexion is next tested with the patient sitting on a couch, the knees and the hips being flexed to relax the hamstrings. Lateral flexion is estimated by asking the patient to bend sideways from the erect position.

Only rarely (in cases of low sciatica) will the shape and mobility of the spine be normal.

In mild cases of the fibrositic variety there is frequently an associated postural defect—usually a hollow back, the lumbar lordosis being increased. In such cases the spine is mobile, although movement may be painful.

When the sciatica is caused by protrusion or degeneration of a disc, by hypertrophy of the ligamentum flavum, or by spinal arthritis, gross deviations from the normal shape of the spine are observed, and the spine may be stiff.

1. A common abnormality is a lateral deviation of the spine which appears only during flexion. When the patient stands upright his spine is straight, but on bending forward, the spine deviates to one side, toward or away from the side of the sciatica (Fig. 12).

2. There may be a fixed exaggerated lordosis. The lumbar spine is stiff and moves en bloc when the patient bends forward, spasm of the erector spinae muscles being visible and palpable. The movement of flexion takes place only at the hips. This type of spine is commonly produced by spinal arthritis (Fig. 13).

3. The flat or kyphotic lumbar spine, sciatic scoliosis, and alternating scoliosis are usually due to abnormalities of an intervertebral disc or ligamentum flavum. In the case of a flat lumbar spine the lumbar lordosis is obliterated and the spine is very stiff. In the kyphotic lumbar spine the deformity has progressed a stage further, the lumbar curve being reversed (Fig. 14). In the sciatic scoliosis we have a flat or kyphotic lumbar spine, which also deviates to one side, usually away from the side of the sciatica, but sometimes toward it (Fig. 15). The lateral deviation starts from a low level, at the lumbosacral junction or just above it, and from this point the spine leans sideways. It is a list to one side rather than a rounded curvature of the sort usually associated with the word scoliosis. The deformity is fixed. Extension is severely limited. The lateral inclination cannot be overcome, either actively or passively. Attempts to straighten the spine are painful. The deformity persists when the patient lies down. Under anesthesia the lateral deviation disappears, but if there is an associated lumbar kyphosis, this usually persists. Alternating scoliosis is rare. In these cases there is a sciatic scoliosis, but the lateral deviation varies in direction from time to time. For instance, the change from one side to the other may be produced when the patient bends forward (Figs. 16 and 17).

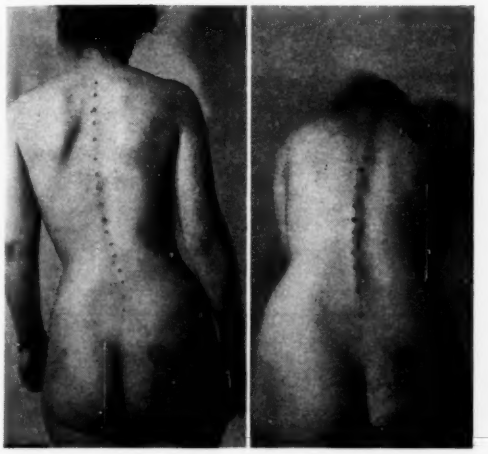

Fig. 16. A case of right sciatica with alternating scoliosis. In the erect position the spine deviates to the left. During flexion the spine deviates to the right. Note the wasting and loss of tone in the right buttock. At operation a "concealed disc" (lumbosacral) was found.

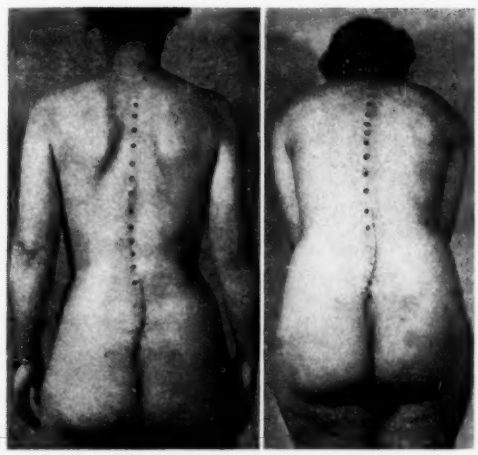

Fig. 17. The same case as in Figure 16, after operation. A laminectomy with ample bone removal was performed. A "concealed disc" was exposed but no disc material was removed. The spinal deformity has disappeared and the sciatic pain is cured.

It is probable that each of these deformities represents a mechanism designed to protect the nerve roots from pressure. There are several factors to be considered. Thus, extension of the spine diminishes the size of the intervertebral foramina by elevating the inferior articular process at each joint, and so may increase the sciatic pain. But, extension of the spine also relaxes the nerve roots and meninges, and so it may relieve the pressure on a nerve root, or permit the nerve to slide into a less vulnerable position. For instance, one of our patients could obtain relief only by lying on her face, i.e., by extending her lumbar spine. Again, flexion of the lumbar spine (lumbar kyphosis) tends to throw into prominence the protrusion of a disc—an undesirable effect; but at the same time it increases the size of the intervertebral foramina and for this reason may be a position of ease. Contralateral scoliosis similarly has a dual effect. It increases the size of the intervertebral foramina on the painful side, but also increases the tension in the nerve roots on that side. Ipsilateral scoliosis, on the other hand, diminishes the foramina on the painful side, but also relaxes the nerve roots on that side. The clinical result thus depends upon the balance of opposed factors and differs from case to case, and in some instances from time to time in the same case (alternating scoliosis).

Tenderness in the back is variable. In functional cases there is widespread exaggerated tenderness which disappears when the patient's attention is distracted. In fibrositis, with which a functional element is frequently associated, the tenderness is similiar.

Localized tenderness over a spinous process, an interspinous process, or an interspinous interval may be a guide to the level of a prolapsed disc, but this sign is unreliable.

Nearly always there is localized tenderness over the sciatic notch, but, apart from this, tenderness in the leg is uncommon. Pressure over the tender area in the buttock may cause radiation of pain down the back of the thigh, but trigger points elsewhere are unusual.

Lasègue's sign. Stretching the sciatic nerve increases the sciatic pain, and serves as a measure of the severity of the sciatica. The test is performed with the patient lying supine on a couch. With the knee kept extended, the affected leg is lifted off the couch. In severe cases the hip flexion is resisted by muscle spasm when the movement has progressed through only 10 or 20 degrees. In mild cases an arc of 70 or 80 degrees is permitted. Flexion of the sound limb in many cases causes either a pain in the lower back, or an accession of sciatic pain in the affected leg, presumably because this movement stretches the structures in the lower back, including the nerve roots on both sides. Ingenious attempts have been made, by modifying the straight-leg-raising test, to differentiate between the various causes of sciatica.

The "head and knee" test described by Young is an example. These refinements have little clinical value.

Wasting may be apparent in the buttock, thigh, or leg. The distribution of the wasting may give some indication of the level of the lesion. If the first sacral root is affected, wasting of the outer buttock (gluteus medius) and of the calf follows, and the ankle jerk is lost. Interference with the fifth lumbar root causes wasting of the anterior tibial compartment, and the ankle jerk is spared.

Loss of power. Actual loss of muscle power is rare, but an apparent loss of power is often seen, because muscle effort is painful and therefore voluntarily limited. Note that muscle power should be tested with the patient standing as well as lying. A slight weakness of the calf muscles, for instance, is best detected by asking the patient to stand on tiptoe.

Abnormalities of sensation. Subjective disturbances (paresthesia or a feeling of numbness) may be the first symptom of sensory impairment. Hyperalgesia and hyperesthesia may occur. Later, actual sensory impairment (light touch, pinprick, postural, or vibration sense) may be found. Although the delineation of the dermatomes is uncertain, and more than one root must suffer significant damage before sensory loss is observed, yet a careful study of the sensory changes may help to localize the responsible lesion (Bradford and Spurling, Pennybacker, Kellgren).

The fifth lumbar root territory includes the dorsum of the foot and the big toe. The first sacral root supplies the outer side of the foot and the outer two toes.

Tendon reflexes. The knee jerk depends on the second, third, and fourth lumbar segments. It is not, as a rule, affected in cases of sciatica. It may actually be enhanced if the tone of the hamstrings is impaired. The ankle jerk is frequently lost or depressed. It depends upon the roots of the fifth lumbar, first sacral, and possibly the second sacral nerves. According to Bradford and Spurling the ankle jerk is affected in 80 per cent of lumbosacral disc prolapses, and in 25 per cent of fourth lumbar disc prolapses, but it must be noted that the ankle jerk may also be affected by a prolapse at a higher level. The ankle jerk is also lost in cases of interstitial neuritis of the sciatic nerve.

Once lost, the ankle jerk may not return, although the sciatica may be cured. An absent ankle jerk does not necessarily indicate active sciatica. It may be the relic of a previous attack.

X-ray examination of the lumbar spine and pelvis is an essential part of the examination of all cases of sciatica. The lateral view should be centered on the fifth lumbar vertebra because the majority of the vertebral lesions which may cause sciatica occur in the lower part of the lumbar spine.

Contrast roentgenography is still used in some clinics for the diagnosis of disc protrusions.

Adverse effects after the injection of iodized oil have frequently been recorded. Verbrugghen reports pain in the legs, backache, nausea, vomiting, retention of urine, pyrexia, meningismus, and an increased cell count in the cerebrospinal fluid. Marcovitch and Walker report pyrexia, vomiting, stiffness of the neck, and increase of cells and protein in the cerebrospinal fluid. They report a fatal case in which, at postmortem, acute meningeal reactions were found in the spine and around the brain stem. Sicard and Forestier noted a brief pleocytosis. Globus found a variable pleocytosis, but there were no adverse effects clinically. Lindblom noted a pleocytosis and positive Nonne and Pandy tests, these signs disappearing within a month. Klose and Peiper reported transient headaches, but no other ill effects. Maclane, Wartenberg, Sharpe and Peterson, Bergerhoff, Nonne, Fumarola and Enderle, Donat and others, also found adverse clinical and pathological changes after the use of iodized oil in the theca. Experimental work in animals has produced similar results (Brucker and Propper, Davis, Haven, and Stone, and Ayer and Mixter).

In 2 of our cases in which lipiodol had been used the roots of the cauda equina were, at operation, seen to be matted together by a yellow fibrinous exudate. The meninges were thickened and injected. These pathological changes were attributed to the use of lipiodol. The patients suffered no permanent harm. Of a further 8 cases in which lipiodol was used and not removed, 1 was made permanently worse (the sciatica was permanently exacerbated), but the remaining 7 presented no immediate ill effects. Two years later, 3 of the 7 were traced and no ill effects had appeared.

Thus it is clear that lipiodol may cause pathological changes in the meninges and nerve roots, but permanent harm is unusual. With pantopaque or with air there is little risk, but the really important fault of contrast roentgenography, its unreliability, remains. With proper roentgen technique a large protrusion would doubtless be revealed by contrast roentgenography in every case. However, in such cases the diagnosis is easily made and the level of the lesion may be determined by clinical examination. On the other hand, a small protrusion, a "concealed" disc, a degenerate disc which is not protruding, and even a disc protruding to a fair degree in a lateral situation, will not

be shown by contrast roentgenography. In other cases contrast roentgenography may falsely indicate a protrusion which does not really exist. Fortunately, the plain roentgenogram often indicates the presence and the level of a degenerate disc. Very slight narrowing of a disc space may be significant if taken in conjunction with the history and physical signs.

Rectal examination must be made in every case of sciatica. It is a simple and almost certain method of excluding pelvic neoplasm from the diagnosis.

Focal sepsis. As previously mentioned, focal sepsis may aggravate a case of sciatica and impair the chance of successful treatment. It is as well, therefore, to examine the teeth, tonsils, and sinuses. In severe cases, and particularly when operative treatment is being considered, the erthyrocyte sedimentation rate should be determined. This factor may indicate concealed focal sepsis. Occasionally, removal of a septic focus is followed by complete and permanent cure of the sciatica.

Lumbar puncture. The protein content of the cerebrospinal fluid is sometimes raised in cases of prolapsed intervertebral disc.

The cerebrospinal fluid was examined in 39 cases in which a prolapsed disc was subsequently found at operation. Only 13 of these presented an increased protein content. In most of them the elevation was moderate, from 50 to 80 mgm. per cent. In 1 case the elevation was 200 mgm. per cent.

In 12 of the 15 cases in which the thickened ligamentum flavum was responsible for sciatica, the cerebrospinal fluid was examined. The protein content was raised in 6 of these.

So far as the question of a prolapsed disc is concerned, a raised protein content supports the diagnosis, but a normal result does not exclude it. We no longer perform this test as a routine procedure.

DIFFERENTIAL DIAGNOSIS

This is often difficult and sometimes impossible.

In the type of sciatica caused by lumbar fibrositis there is a history of one or more attacks of lumbago preceding, or associated with, the sciatic pain. There is widespread tenderness in the lower back. The lumbar spine may be moderately stiff, but it is not deformed. There is no loss of motor power in the affected leg and no sensory loss. The ankle jerk is unaffected. Thus, in the typical case, there is no loss of conduction in the affected nerve. Trigger points may be present, but they are rare. A roentgenogram of the spine shows no significant abnormality. Speaking generally, fibrositis gives rise to many symptoms but few signs. In this type of case, particularly, there is frequently a functional element which makes treatment unsatisfactory.

The diagnosis of spinal arthritis is suggested when the patient is over 40 years of age and has a stiff spine with spasm of the erector spinae muscles and a fixed lumbar lordosis. The roentgenogram may support the diagnosis. Signs of interference with conduction in the affected nerve roots may or may not be present. If the arthritic joints are producing referred pain, there is no loss of conduction, but a severe arthritis may provoke inflammatory changes around the root sufficient to interfere with conduction and produce abnormal neurological signs, usually of a minor degree (73). Differentiation between spinal arthritis and prolapsed disc may be impossible without an exploratory operation. Lumbar puncture may be done in doubtful cases. A raised protein content would favor the diagnosis of prolapsed disc, but it should be noted that according to Putti (73) the protein in the cerebrospinal fluid may be elevated in the neighborhood of an arthritic lateral joint.

Some cases of prolapsed disc and thickened ligamentum flavum are easily recognized. For instance, a young man develops sciatic pain soon after injury or strain of the back. On examination the lumbar spine is seen to be rigid and deformed. The normal lordosis has been lost, the spine being either flat or kyphotic, and there may also be a lateral deviation, "sciatic scoliosis." There is some wasting of the leg, some loss of muscle power, and some sensory loss. The ankle jerk is absent. The roentgenogram may show narrowing of a disc space. The sciatica is caused by a prolapsed or degenerated intervertebral disc, by a hypertrophied ligamentum flavum, or by both.

In typical cases of this sort, it is not difficult to decide the diagnosis and advise appropriate treatment. Unfortunately, there is a considerable number of patients with equivocal physical signs. A prolapsed disc or hypertrophied ligamentum flavum may produce signs which are not striking, stiffness being only moderate and deformity absent, and there may be no interference with conduction in the nerve. The roentgenogram may give no assistance. The protein in the cerebrospinal fluid may be within normal limits. It is also to be noted that prolapsed discs may (rarely) occur in the middleaged and elderly as well as in the young, and that the history as regards injury is not a reliable guide.

Clearly, there are ample possibilities of error in diagnosis. However, there is usually some pointer.

For instance, if the spinal signs are slight, interference with conduction in the nerve may suggest the diagnosis, and if there are no abnormal neurological signs, the spinal deformity may be sufficiently severe. Rarely, there may be only trivial spinal signs, nothing more than a slight painful limitation of flexion and extension of the lumbar spine, and no abnormal neurological signs whatever. We have had a few cases of this kind in which lumbar puncture has given the clue, yielding cerebrospinal fluid with a raised protein content; but even this indication may be lacking.

Certain combinations of signs and symptoms which recur may be recognized as clinical types.

a. Early stages of disc degeneration may be associated with very remarkable deformities and stiffness of the spine (Figs. 14, 15, 16, and 17). We have noticed an inverse relationship between the spinal signs on the one hand, and the size of the protrusion and the neurological signs on the other hand. In the young patient with severe spinal deformity and rigidity, but without any neurological abnormality, an early disc degeneration is nearly always found. It is an immature degeneration causing referred pain. Thus, a young patient, in the third decade, has gross spinal rigidity and deformity. His lumbar spine is kyphotic, with or without an accompanying scoliosis. There are no abnormal neurological signs. The protein of the cerebrospinal fluid is within normal limits. The roentgenogram is normal. At operation a degenerated disc is identified by its abnormal and irregular consistency. There is no protrusion, or, at the most, a tiny eminence of the kind called, by Dandy, a "concealed" disc.

b. An older patient in the fourth or fifth decade, has sciatica with some abnormal neurological signs, showing interference with conduction in the affected nerve. The spinal signs are not marked. On standing erect, the lumbar spine appears normal. On bending forward, the spine deviates to the side, away from or toward the sciatic leg (Fig. 13). There is a moderate elevation, from 60 to 100 mgm. per cent, of the protein content of the cerebrospinal fluid. At operation a large protrusion is found in close relation to a nerve root. This is a mature degeneration. There is frank protrusion. Pressure upon a nerve root has developed, but the spinal signs are comparatively trivial. We have already remarked that spinal signs and neurological signs tend to vary in inverse proportion.

c. There are some difficult cases which have few signs of any kind. Thus, a patient with sciatica has a little tenderness in the back. The lumbar spine is not deformed. There is only slight painful restriction of the movements of the lumbar spine. Conduction in the sciatic nerve is normal. The protein level of the cerebrospinal fluid is normal or only slightly raised (50 or 60 mgm. per cent). The diagnosis is dubious. Operation is decided upon because pain persists in spite of conservative treatment. The operative findings are a minor protrusion or a hypertrophy of the ligamentum flavum.

In doubtful cases it is a good plan to watch the patient for a time. Time enables the surgeon to assess the degree and reality of the pain, and it may bring forth some abnormal sign to clarify the diagnosis. It may even solve the problem by the occurrence of a spontaneous cure.

When abnormal neurological signs are present, the clinical picture is that of a lesion at the root level. Among the possible causes to be considered, spinal tumors are rare; bony disease is rare and easily excluded by clinical and roentgenological examination; and radiculitis, such as occurs in the cervical region, causes paralysis rather than pain, with recovery—a sequence unusual in sciatica. Disc protrusion is therefore by far the most likely diagnosis. Yet even in such cases a degenerated disc is not always present. Thus, in the present series there were 4 cases with abnormal neurological signs, in which it was proved at operation that the discs were normal. The case records are given as follows:

Case 1. Male, aged 26 years. While lifting a heavy weight 3 years previously his back "gave way". After that he had backache with left sciatica.

There was marked stiffness of the spine with a list to the left and hypesthesia on the outer side of the left leg; the left ankle jerk was depressed; the Lasègue sign was positive on the left side at 30 degrees; the protein content of the cerebrospinal fluid was 40 mgm. per cent; and the roentgenogram made with the use of lipiodol was negative.

Laminectomy revealed neither a thickened ligament, nor a prolapsed disc. There was no abnormality.

The operation cured the patient completely for 6 weeks. Then the pain recurred. In a letter one year later the patient wrote that he had continuous aching pain in the back and left leg and that his left leg felt numb between the knee and ankle.

Case 2. Male, aged 57 years. The patient had several attacks of sciatica on the right side culminating in a severe attack 3 months before operation.

There was a flat, stiff lumbar spine with a list to the left, and tender areas over the right sacroiliac joint, the right sciatic notch, and the right sciatic nerve in the thigh and calf; the Lasègue sign was positive at 45 degrees; there was weakness of dorsiflexion of the right foot; ½ inch wasting of the right calf; hypesthesia on the lateral part of the right calf and outer part of the dorsum of the foot; the right ankle jerk was depressed; the protein content in the cerebrospinal fluid from the interspace L.4 to 5 was 35 mgm. per cent; the roentgenogram showed osteoarthritis of the lumbar spine; and the roentgenogram made with the use of lipiodol showed a symmetrical filling defect at the level between L. 4 and 5.

Laminectomy revealed neither a prolapsed disc nor a thickened ligamentum flavum. On opening of the dura the nerve roots of the cauda equina were matted together with a yellow exudate. (This was one of the cases in which the lipiodol had provoked a reaction.) There was also a misleading appearance of a filling defect.

The immediate result was that the patient was cured of all pain. A year later there was no pain at all. The patient said that his back felt weak. There was slight weakness of the peronei (right); also hypesthesia of the outer part of the dorsum of the right foot.

Case 3. Male, aged 32 years. For ten years, on and off, he had had sciatica on the right side, which had become worse since he lifted a heavy weight 5 years ago.

The dorsal kyphosis had increased; there was spasm of the erector spinae and flexion of the lumbar spine was limited; extension was limited and painful; there was tenderness over the fourth and fifth lumbar spines, and over the right sacroiliac joint; the Lasègue sign was positive on the right side at 40 degrees; the right calf was wasted; there was hypesthesia to pin prick on the posterolateral aspect of the right thigh and outer part of the right calf; vibration sense was absent over the right tibia; the postural sense of the right toes was impaired; the right ankle jerk was absent; the roentgenogram showed no abnormality. The lateral joints were all in the coronal plane and therefore not clearly visualized.

Right hemilaminectomy was done. There was no abnormality of the intervertebral discs of the ligamentum flavum. A spinal arthrectomy was performed on the right side.

The immediate result showed much improvement with no pain; the sensory signs had disappeared.

Fifteen months later the patient was cured. There was no neurological abnormality, and only occasional backache.

Case 4. Male, aged 30 years. He had had sciatica on the left side for 9 months.

The lumbar spine was stiff. There was tenderness over the third and fourth lumbar spines. The Lasègue sign was positive on the left at 50 degrees. There was marked loss of power in the dorsiflexors of the left foot. The protein content of the cerebrospinal fluid was 25 mgm. per cent. The roentgenogram showed anomalies of articular tropism. There was osteoarthritic lipping of the lumbar vertebrae.

Hemilaminectomy on the left side showed no abnormality of the intervertebral discs or ligamentum flavum. A spinal arthrectomy was done on the left side. (At operation the lateral joints on the left side appeared to be subluxated.)

The immediate result was a complete relief of pain. Later there was no sciatic pain but a little backache from time to time.

Evidently the intervertebral disc is not the only factor to be considered.

In Table II the diagnoses made in the 249 consecutive cases are shown. In this series, there were 129 cases with neurological abnormality. Table III shows the diagnoses made in this group. It will be seen that there were 54 cases in which the diagnosis was doubtful. It is the fashion nowadays to dispose of these cases by saying that they must all be protruded discs. This view is incorrect, as shown by the operations described previously.

Of the 54 cases undiagnosed, some, we may suppose, were disc lesions; others no doubt were caused by lateral joint arthritis, and there may also have been other factors not yet elucidated.

TABLE II.—DIAGNOSES IN THE CONSECUTIVE SERIES OF 249 CASES

Fibrositis	94
Prolapsed disc	40*
Lateral joint arthritis	41†
Ligamentum flavum	3
Ankylosing spondylitis	4
Spinal tumor	1
Spondylolisthesis	1
Diagnosis uncertain	65
Total	249

*Clinical diagnosis verified at operation in 15.
†Diagnosis on roentgen findings.

TREATMENT

Certain methods of treatment and the results obtained will now be described.

In an acute attack of sciatica the pain may be agonizing and may continue at this pitch for days and even weeks.

Palliative Treatment

1. Complete rest in bed. The patient is allowed to lie in whatever position he finds most comfortable. The long Liston splint, which is sometimes advised, does no good because the patient will not tolerate it when tightly applied and a loosely bandaged splint soon becomes merely an irritating appendage which prevents him from finding a comfortable position. Skin traction is also recommended by some writers. In my experience it gives no relief. The best plan is to support the patient with pillows in whatever position he obtains most relief from pain. Skillful nursing is obviously most important in this respect. A well sprung mattress should be provided.

2. Analgesic Drugs. For severe cases morphia will be required. When the pain becomes less intense, cachets containing pyramidon (gr. 5), medinal (gr. 3), and codein (gr. ¼) (Harris) are useful, and at a later stage aspirin and phenacetin may be used. Medinal (gr. 7½) may be given at night.

TABLE III.—129 CASES WITH LOSS OF CONDUCTION

Diagnosis proved by operation (Discs, lateral joint arthritis, ligamentum flavum, spinal tumor).	44
Diagnosed as disc protrusion but not operated upon	16
Diagnosed as lateral joint arthritis on roentgen findings	15
Remainder	54
Total	129

3. Local applications. The affected limb should be painted with liniment methyl salicylate, with glycerine and belladonna, or with lead and opium lotion, and wrapped loosely in cotton wool.

4. Radiant heat or diathermy may be applied daily. Massage should not be used. Light massage is useless, and deep massage is too painful.

5. Care of the bowels. This may be difficult. Aperients should be given if the patient is constipated. If the pain is severe, he will not be able to use a bed pan and will have to be lifted out of bed to a commode.

6. Oxygen injection into the affected limb, as described by Martin, is a local measure which is useful in the acute and subacute stages of sciatica, although it is difficult to see why it should be so. It undoubtedly gives dramatic relief in many cases. The oxygen is bubbled slowly from a "Sparklet" containing 1 liter, or from an ordinary oxygen cylinder with a fine adjustment valve, through warm water, and it enters the thigh through a Record needle ½ mm. in diameter which is introduced subcutaneously. Sterilized rubber tubing is used. The injection is continued until the thigh is moderately ballooned by the gas. If the pain returns, the injection may be repeated.

The treatment of chronic or recurrent sciatica is based as much as possible on the cause of the pain. In our series there were 15 cases which were thought to be due to fibrositis of the buttock and thigh. They were treated empirically by attention to focal sepsis, by physiotherapy, by stretching the sciatic nerve, and by perineural injection of saline solution. These measures gave temporary relief but there were no cures. The symptoms persisted for months and in some cases for years.

Perineural injection. The surface marking of the exit of the sciatic nerve from the pelvis is at the junction of the middle and outer thirds of a line joining the posterior superior spine of the ilium with the tip of the great trochanter. This is also, as a rule, the point of maximum tenderness. In making a perineural injection, the needle is inserted at this point and is pushed gently in until it touches the sciatic nerve. The surgeon can tell when the sciatic nerve is reached by the twitching of the foot which is instantly provoked. When this occurs, the needle is withdrawn a little and from 80 to 100 c.c. of normal saline solution at blood heat are injected around the nerve. This injection is usually described as intraneural, but clearly it must be perineural. The sciatic nerve will not accommodate a large volume of fluid, and if the saline solution could be forced into the nerve it is difficult to see what good would ensue. The supposed rationale of the perineural injection is to balloon the intermuscular spaces in which the nerve is lying and so to disrupt the adhesions around the nerve. Perineural injection is an uncertain method of treatment, but it is harmless and sometimes produces good results.

Stretching the nerve. While the patient is anesthetized, the sciatic nerve is stretched by flexion of the hip, the knee being held in full extension and the ankle in full dorsiflexion. The flexion of the hip should be forced as far as possible, short of dislocating the joint. "Adhesions" may be heard to give way in the thigh during this maneuver.

For sciatica caused by lumbar fibrositis, rest, physiotherapy, and attention to focal sepsis are the first steps in treatment. For severe or moderately severe cases, complete rest in bed should be insisted upon. If the pain still persists, an epidural injection should be tried and this may be combined with manipulation of the spine.

Sciatica caused by spinal arthritis, prolapsed intervertebral disc, or thickened ligamentum flavum is treated first of all by rest. The patient is confined to bed for 3 or 4 weeks. If during this time there is significant improvement this conservative line of treatment is continued, and in some cases proves successful.

Case 1. Male, aged 26 years. He had very severe left sciatica for 6 months.

The lumbar spine strongly indicated a disc lesion. There was marked kyphosis and a list to the right. The spine was very stiff.

The Lasègue sign was positive on the left side at 20 degrees. There was marked wasting of the left thigh and calf and general weakness of the left leg. There was no sensory loss. The left ankle jerk was absent. The protein content of the cerebrospinal fluid was 120 mgm. per cent. The roentgenogram showed no significant abnormality.

With complete rest in bed the patient rapidly improved. He was kept in bed for 3 months. The pain disappeared. Eighteen months later he wrote to say that he had no sciatic pain. His back felt weak, but he had been able to resume his work as a bank clerk and had been able to work in his garden in his spare time.

This was almost certainly a prolapsed disc.

Case 2. Male, aged 52 years. Six months before his first attendance he fell heavily on both buttocks and subsequently had persistent lumbar backache, which after 2 or 3 months began to radiate into the back of the right thigh and calf. When first seen, 3 years ago, he had severe right sciatica.

The lumbar spine was stiff and flat. The Lasègue sign was positive on the right side at 15 degrees, and on the left side at 30 degrees. No wasting occurred, and there was no loss of power. There was slight diminution of postural sensibility in the toes of the right foot. The vibration sense was diminished in the right leg. The right ankle jerk was absent. The roentgenogram showed arthritic changes in the lumbar spine.

Treatment consisted of rest in bed and physiotherapy.

Three months later his condition was much improved. There was sensory loss on the outer border of the right foot. In his present condition (3 years after the onset) there is

no spontaneous pain. Slight aching pain in the lower back and in the back of the right thigh occurred after exercise. The Lasègue sign was negative on both sides. There were no abnormal neurological signs.

This sciatica was probably caused by arthritis of the lateral joints.

It is advisable to give rest a trial, even in cases with physical signs of an intraspinal lesion. Operation should be considered only after prolonged rest in bed has been tried and has failed, unless the presence of severe symptoms forces the surgeon's hand. The tedium of the stay in bed is beguiled daily with physiotherapy, and the usual clinical, laboratory, and x-ray investigations are performed without undue haste, over a period of 2 or 3 weeks. By this time it will be possible to decide whether continued rest is likely to produce an improvement. Some patients improve up to the point where, by a careful regime, avoiding exposure and excessive strain, they can be kept fairly comfortable and fit for business.

In some cases, pain disappears suddenly. For instance, one of our patients with chronic sciatica suddenly became free from pain as she was stepping out of her bath one morning. She said she felt that "something had moved in her back."

Sudden improvement may occur because the nerve root involved has moved into a position less exposed to pressure, or the protruding part of the disc may have separated completely and moved away from the root on which it was pressing. This had happened in 1 of our cases, in which a fragment the size of a pea was found completely detached, in the epidural space, over the body of the fifth lumbar vertebra.

If rest produces no significant improvement, epidural injection, combined in some cases with manipulation of the spine, is the next line of treatment. If the pain still persists, the question of operation arises, and will be decided by the age and general condition of the patient, his occupation, and the degree of disability. For some individuals a spinal support is the best treatment.

Epidural injection. Pentothal anesthesia is used. The patient lies on his side. The cornua of the sacrum are identified and the posterior surface of the coccyx palpated below them. A Labat's needle is inserted horizontally between the cornua and directed headward and slightly forward. The needle will enter the canal of the sacrum without any difficulty. It is pushed in for about an inch. With a Labat's 20 c.c. syringe with a two-way attachment, a large volume of normal saline solution, previously warmed to blood heat, is injected. As a rough guide 250 c.c. are taken as the correct volume. It is necessary to use a large volume because the fluid acts mechanically. As the injection proceeds it fills first the sacral canal, and then is forced upward into the lumbar canal outside of the dura. As more fluid is injected and the pressure inside the canal increases, the fluid escapes laterally through the intervertebral foramina and in doing so it disrupts any adhesions which have formed around the nerve roots, e.g., in association with arthritic changes in the lateral joints. That is the supposed rationale of the injection. Sometimes there is ocular proof that the fluid has in fact escaped through the intervertebral foramina, as a swelling appears under the erector spinae muscle on one or both sides. A considerable degree of force is necessary to impel the fluid up the canal and the injection is usually a laborious and tedious business. Morphia may be required the first few hours after the injection.

There are two possible errors in making this injection. The needle may be put in too near the surface and so lie on the posterior aspect of the sacrum instead of inside of it. The operator will detect this error at once because the first syringeful will produce a swelling over the sacrum. The second error is to push the needle in too far, so that it enters the dural sac. This will not happen if the needle is inserted only 1 inch.

This injection is worth trying because it is harmless and sometimes produces a dramatic and lasting cure. Some diagnostic importance has been claimed for the epidural injection in that it is said to cause an exacerbation of the pain from a prolapsed intervertebral disc. We have not found this to be the case.

Manipulation of the spine is performed under pentothal anesthesia. If combined with epidural injection it should be done first, while the relaxation is complete. The method described by Bankart is used.

There are four movements to be carried out, namely:

1. Flexion. The surgeon stands on the right hand side of the supine patient, and places his right arm under the patient's knees. He lifts the legs up, flexing the hips and knees, and carries the knees upward until they are pressed on the patient's chest. The fullest possible flexion of the lumbar spine is thus obtained.

2. Rotation to the left. The patient lies on his right side. The left leg hangs over the side of the table, and the left arm is placed behind the patient's back. The surgeon leans with his right forearm on the left iliac crest, while with his left hand he grasps the left shoulder. A forcible rotatory movement of the sacroiliac joint is produced by pulling the iliac crest forward and pushing the shoulder backward.

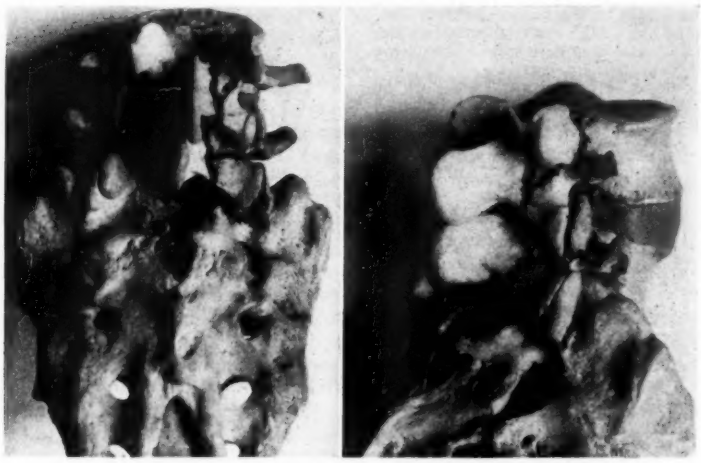

Fig. 18. Lines of bone section for the operation of spinal arthrectomy.

3. Rotation to the right. The surgeon goes to the other side of the table and the patient is turned on to his left side. The maneuver described above is repeated.

4. Extension. The patient is turned on to his face. With his left arm the surgeon lifts the patient's legs until they are almost vertical, and with his right hand presses downward over the lumbar spine, extending it as much as possible.

The manipulation is followed by a course of spinal exercises, radiant heat, and deep massage.

Most patients with sciatica have stiff spines, and manipulation of the spine as an empirical method of treatment was much employed when prolapsed intervertebral discs were less frequently diagnosed. It is now in disfavor because it has been said that manipulation may make an unsuspected prolapse worse, and perhaps even precipitate a paraplegia. We have never seen any ill result from the operation and have heard of only one, in a patient who developed sensory loss in the leg and foot immediately after a manipulation of the spine (Dick, 1943). Friberg has shown experimentally that the most powerful flexion or extension of the lumbar spine has no effect on artificially produced prolapses. The risks of manipulation are evidently small. We still think it is worth trying a manipulation, except in those cases which have the typical signs of a prolapsed disc.

Operative Treatment of Sciatica

The operations to be considered are spinal arthrectomy and laminectomy. (We have seen 5 cases in which Ober's (66) operation had been performed elsewhere. The result in each case was unsatisfactory.)

Spinal Arthrectomy. This operation was mentioned by Putti (73). It has been elaborated and extensively used by Bankart.

The steps of the operation are as follows (Figs. 18, 19, 20).

1. A midline incision is made over the lower 3 lumbar spines and the upper part of the sacrum.

2. With a sharp chisel, the erector spinae muscles on each side are reflected from the spinous processes, throughout the length of the incision.

3. On the affected side, the reflection is continued laterally until the lateral joints L 3 and 4, L 4 and 5, and L 5 and S 1 are exposed. The end of a Bristow elevator is placed on the outer side of each joint, to act as a landmark and retractor. These joints are dealt with seriatim in the following manner:

4. The inferior articular process of the upper vertebra is isolated by cutting through the lamina with an osteotome or with Lane's gouge forceps.

5. This articular process is removed with Lane's gouge forceps.

6. The base of the superior articular process of the lower vertebra is cut through with an osteotome.

7. This articular process is removed with Lane's gouge forceps.

What is the principle of the arthrectomy operation? How does it work? It was originally designed to cure sciatica by removing the lateral joints, on the assumption that these arthritic joints were causing sciatic pain. But clearly there are other

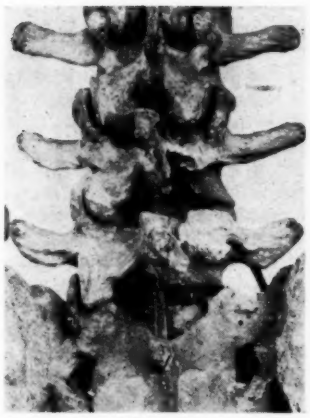

Fig. 19.

Fig. 20.

Fig. 19. Spine after spinal arthrectomy. The joints between L4 and 5 and L5 and S1 on the right side have been removed. The black cord represents the fourth nerve root.

Fig. 20. Roentgenogram taken 4 years after spinal arthrectomy on the right side.

effects of arthrectomy. Every arthrectomy is necessarily also a hemilaminectomy. The lateral parts of the laminae and ligamentum flavum are excised, in addition to the lateral joints; the effect of this is to remove the posterior wall of the spinal canal on the affected side, and also the posterior wall of the intervertebral foramen. If the diagnosis is mistaken and the sciatica is really caused, not by spinal arthritis, but by a protruded disc (a lateral protrusion especially), or by hypertrophy of the ligamentum flavum, the environment of the nerve root may yet be altered sufficiently to produce a cure. In this connection it should be noted that the first step of the arthrectomy operation is an exposure of the laminae. It is a good plan to expose the corresponding disc at this stage. It is easily done by removing the ligamentum flavum and exploring the interlaminar space. If an abnormal disc is found, this can be dealt with. If the discs are normal, the arthrectomy is completed.

Laminectomy. In the modern operation for prolapsed disc only the necessary minimum of bone is removed, but I prefer to make a wide exposure and remove a considerable amount of bone on each side of the interspace. This allows a full view of the disc and nerve root and permits the surgeon to see clearly what he is doing. It also gives the nerve root a margin of safety from subsequent compression by a recurrent protrusion or by scar tissue. (In 1 of our patients [not included in the present series] a protrusion was removed from the fourth disc through a narrow exposure, only a tiny portion of bone being removed from the lamina of the fourth lumbar vertebra. The pain, never completely relieved, soon returned and became worse than it had been before the operation. At the second operation, 6 weeks after the first, the only abnormality found was a dense mass of scar tissue which had formed around the fourth lumbar root. This was dissected out and bone was removed widely on both sides of the interspace. This relieved the pain completely.)

For laminectomy the patient lies on his side, with the affected side uppermost.

1. A midline incision is made from the lower border of the third lumbar spinous process to the second sacral spinous process.

2. With a sharp chisel the erector spinae muscles are reflected on both sides; packing is done at the same time.

3. The packing is removed, and further dissection is done to expose the laminae and the ligamentum flavum.

4. The spinous process of the fifth lumbar vertebra is excised.

5. The ligamentum flavum between the fifth lumbar and first sacral vertebrae is excised. On the affected side particularly the lateral part of the ligament, which sometimes extends far outward and is in contact with the issuing nerve root (fifth lumbar), is dissected.

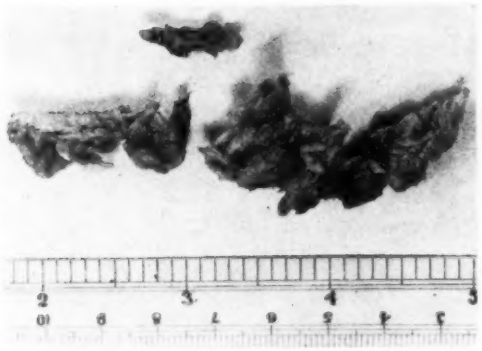

Fig. 21. Portion of intervertebral disc removed at the second operation in a case of sciatica. At the first operation a large protrusion of the fifth disc was found and a piece of disc material the size of a small cherry was removed. This operation gave complete relief from pain but the sciatica recurred after 2 years. At the second operation the material shown above was removed. This operation relieved sciatic pain, but backache persisted.

6. The interlaminar space is enlarged with Lane's gouge forceps, the bone being taken away in small bits from the contiguous margins of the fifth lumbar and first sacral laminae, until free access to the dura is obtained.

7. By blunt dissection and gentle swabbing with cotton wool pledgets, the dura and the fifth lumbar nerve root are exposed and cleansed; the nerve root will be seen coursing inside its dural sheath to the intervertebral foramen.

8. With a blunt hook, the root is gently retracted outward, and the theca is gently pushed inward with a Macdonald's raspatory.

9. The floor of the canal, so exposed, is explored for a protrusion. If a protrusion appears, the overlying posterior ligament is incised and the loose portions of the disc are removed. When all that is loose has come away, the surgeon should be satisfied. Nothing is gained by curettage or removal of the remainder of the disc. Removal of a prolapsed disc should mean removal of the loose portions only. Only the part that is loose should be removed, and no more.

10. Occasionally, a midline protrusion can be felt, but it will not be properly exposed, by the steps described. In such cases, the dura should be opened. The protrusion is then excised transdurally.

11. If nothing is found at the fifth interspace, the fourth interspace should be explored and if that is also normal, the third interspace should be explored. (The vast majority of protrusions occur at either the fourth or fifth interspace).

Operation for concealed disc and degenerated disc without protrusion. We have referred already to the cases in which only a tiny protrusion (concealed disc) or a degenerated disc, not protruding, is found. There is clearly no question of relieving pressure on a nerve root, since no root is being pressed upon. If removal of disc tissue is attempted, it may be found that there is a little shreddy fibrous tissue in the superficial layers, but there is no loose material. In such cases we do not remove any material from the disc. I do not believe that biting out the disc tissue with a punch serves any useful purpose. Therefore, when the nature of the lesion has been verified, the incision is closed.

The results, immediate and remote, are less satisfactory in these cases of concealed disc than in those in which there is a definite protrusion. Relief from pain is slower and less complete. This is an important consideration in selecting cases for operation.

In the operation for a concealed disc a wide exposure, with ample resection of bone, is a valuable precaution, since a protrusion may occur subsequently if the degeneration of the disc progresses.

RESULTS OF TREATMENT

Follow up proved to be difficult and is incomplete. Due to war time difficulties many patients could not be traced.

The military cases were (with the exception of certain operative cases) excluded from the review of the results of treatment. Comparison of the results in civilian life with those in Service patients is seldom valid. The remaining cases totalled 206, as follows:

Cases treated by physiotherapy alone	19
Cases treated by manipulation of the spine and stretching of the nerve	25
Cases treated by epidural injection	37
Cases treated by open operation	125
Total	206

1. Results of physiotherapy (19 cases). The average duration of attendance was 30 weeks. On follow up 3 years later 6 patients were symptomless, 6 still had pain, and 7 could not be traced.

2. Results of manipulation of the spine and stretching of nerve (25 cases). The average duration of attendance was 25 weeks (the manipulation being followed by physiotherapy).

There were no quick cures but most patients derived subjective benefit from the manipulation.

On follow-up 3 years later, 5 patients were symptomless, 6 still had pain, and 14 could not be traced.

3. Results of epidural injection. This was often combined with manipulation of the spine and was usually followed by physiotherapy.

In 14 cases with no neurological abnormality the average duration of attendance was 16 weeks.

In 1 of these cases there was complete relief of pain after the injection.

Most of the patients obtained considerable, but not complete, relief.

On follow up 3 years later, 3 patients were symptomless, 6 still had pain, and 5 could not be traced.

In 23 cases with abnormal neurological signs the average duration of attendance was 22 weeks.

Immediate results: 9 patients were cured, 8 were benefited, 4 were not benefited, and for 2 no record was available.

On follow up 3 years later, 12 patients were symptomless, 6 still had pain, and 5 could not be traced.

In 3 of the patients without symptoms the abnormal neurological signs and the spinal deformity and stiffness had disappeared.

Thus, altogether there were 37 cases treated by epidural injection, and in 10 there was immediate and lasting relief of pain.

On follow up of these 37 cases 3 years later, 15 of the patients were symptomless, 12 still had pain, and 10 could not be traced.

The results of epidural injections are noticeably better in the group with abnormal neurological signs, as might be expected. Epidural injection is certainly worth a trial as it is harmless, it nearly always gives some relief, and in a proportion of cases it produces a complete cure.

4. Results of operation (125 cases). There were 55 arthrectomies and 70 laminectomies.

Arthrectomies (55 cases). Detailed records of the state of the lateral joints excised in these operations are not available. In some cases there was gross arthritis; in some there was subluxation of one or more joints; in a proportion there was no macroscopical abnormality.

Immediate results: 39 patients were completely cured, 3 were benefited, and 13 patients were not benefited.

Of the 39 "cured" patients, 25 remained symptomless, 10 had recurrence and 4 could not be traced.

Three of the patients with recurrence subsequently had an exploratory laminectomy because the pain persisted. In all 3 a thickened ligamentum flavum was removed.

The results of these 3 operations showed that 1 patient was cured, 1 was benefited, and 1 had no benefit whatsoever.

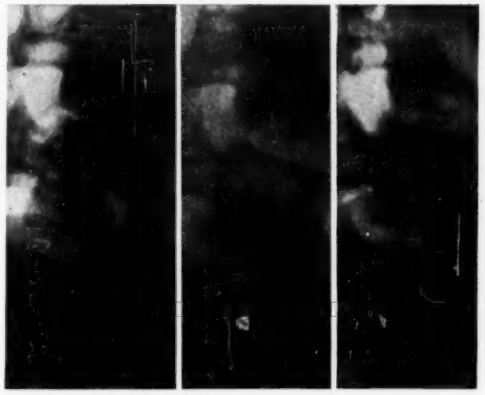

Fig. 22. Roentgenograms of the case referred to in Figure 21. The preoperative roentgenogram was normal. The first operation was performed in 1941 and the second in 1943. Note progressive narrowing of the disc.

In 2 cases the recurrence was on the opposite side. In 1 of these a further arthrectomy on that side was performed which cured the recurrence.

Follow up of the 3 patients who were benefited showed that 1 was cured, 1 was still having pain, and 1 could not be traced.

Follow up of the 13 patients on whom the operation was a failure showed that 1 had recovered, 1 was cured by subsequent spinal fusion, 1 was cured by injection of the nerve, 1 was cured by removal of the ligamentum flavum, 6 were still having pain, and 3 could not be traced.

Thus, of the 55 patients, at the follow up 2 to 3 years later 30 were symptomless (5 of these having had other treatment since the arthrectomy), 17 still had pain, and 8 could not be traced.

A complete and lasting cure, apparently attributable to the arthrectomy, was obtained in 25 of the 55 cases.

Laminectomy (70 cases). The operative findings were as follows:

a. Abnormal intervertebral disc with or without associated thickening of the ligamentum flavum, (40 cases).

b. Thickening of ligamentum flavum (no prolapse of disc) (14 cases).

c. No pathology discovered in disc or ligamentum flavum (15 cases).

d. Spondylolisthesis (1 case).

a. Abnormal intervertebral disc (40 cases): civilian (23 cases) and military (17 cases).

The immediate results in the civilian cases showed that 21 patients were cured, 1 patient was benefited, and 1 was not benefited.

Fig. 23.

Fig. 24.

Fig. 25.

Fig. 23. Roentgenogram taken 5 years after a protrusion of the fifth lumbar disc was removed. The preoperative roentgenogram was normal. This film shows narrowing of the fifth disc and also of the fourth disc.

Fig. 24. Roentgenogram taken 4 years after a protrusion of the lumbosacral disc was removed. The preoperative roentgenogram was normal. This film shows narrowing of the fifth disc and also of the fourth disc.

Fig. 25. Roentgenogram taken 3 years after a protrusion of the fourth disc was removed. The preoperative roentgenogram was normal. This roentgenogram shows narrowing of the fourth disc and also of the fifth disc.

Follow up after from 1 to 5 years showed that 11 patients were cured, 5 had a slight recurrence, 3 had marked pain, and 4 could not be traced.

Two of the cured patients complained of weakness of the back and 1, although without sciatic pain, had persistent pain in front of the thigh.

The results from 12 to 18 months after operation in the military cases showed that no patients were cured, 5 were benefited, and 12 were not benefited.

After from 1 to 5 years, 6 of the military patients were in Category E and 11 were in Category C. (British Army Medical Classification.)

Thickened ligamentum flavum—(14 cases). The immediate results showed that 10 patients were cured, 3 were benefited, and 1 patient was not benefited. Follow up after from 1 to 5 years later showed that 5 patients remained symptomless, 6 had some sciatic pain, and 3 could not be traced.

No pathology discovered in disc or ligamentum flavum (15 cases).

Of these patients, 9 were subjected to spinal arthrectomy either combined with laminectomy or followed by laminectomy and the results have already been considered.

The remaining 6 cases include the 2 in which an exudate (considered to be the result of lipiodol injection) was found around the nerve roots.

The immediate results showed that 4 patients were cured, 1 was benefited, 1 not benefited.

Follow up after from 1 to 5 years showed that 3 patients remained symptomless, 1 patient had some sciatic pain, and 2 patients could not be traced.

Spondylolisthesis (1 case). Laminectomy was performed. There was no disc protrusion. A spinal fusion was done. The patient obtained partial relief.

TABLE IV.—THE OPERATIONS AND THE TOTAL RESULTS

Result	Disc	Ligt. flavum	No Pathology	Spondylolisthesis	Arthrectomy	Total
Cured	11	5	3	0	25	44
Still having pain	24	6	1	1	22	54
Not traced	5	3	2	0	8	18
Total	40	14	6	1	55	116

Fig. 26.

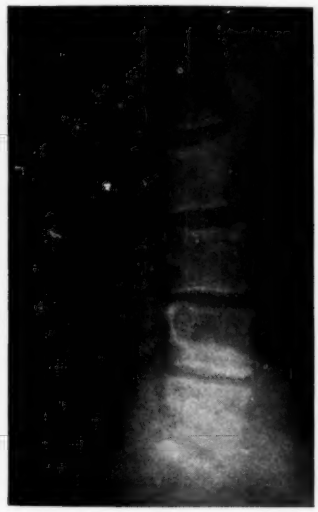

Fig. 27.

Fig. 26. Roentgenogram taken 3 years after a "concealed disc" (lumbosacral) had been exposed. At the operation no disc material was removed. The preoperative roentgenogram was normal. This roentgenogram shows narrowing of the fifth disc and also of the fourth disc.

Fig. 27. Roentgenogram taken 3 years after a protrusion of the fifth disc was removed. The preoperative roentgenogram was normal. This roentgenogram shows narrowing of the lumbar sacral disc and also of the third and fourth discs.

The consolidated operative results are shown in Table IV. Following the disc operations (including the military cases), 11 of 40 patients were cured (27%), or 11 of 35 cases that were traced were cured (31%).

Following arthrectomy, 25 of 55 patients were cured (45%), or 25 of 47 cases that were traced were cured (53%).

This survey is incomplete because of the wartime difficulty of follow-up, but it is sufficiently clear that the results of operation for disc protrusion are not uniformly good. It must, however, be emphasized that the results are satisfactory in the sense that when pain persists or recurs it is never as severe or disabling as the preoperative pain.

All the civilian patients were satisfied with the operation.

The possible causes of persistence or recurrence of pain after operation are obvious. The disc necessarily remains defective after operation whether it is a concealed, bulging, or degenerated disc from which no material is removed, or a disc with a definite sequestrum. In the last case, excision of the sequestrum removes the immediate cause of the pain, but it does not restore a normal anatomy. The spinal blemish is permanent and may be a cause of reflex pain. It also weakens the back, and patients do, in fact, frequently complain of continued backache and a feeling of weakness in the back after operation. Further, a recurrent protrusion may occur. Love and Walsh report recurrence in 2 per cent of their cases.

In our series there was 1 case of proved recurrence in which, 2 years after removal of a prolapsed nucleus had completely cured the sciatica, severe recurrence of pain occurred on the same side. A second operation was performed, and a large protrusion at the same level was removed. Much material came away, as though almost the whole of the disc remaining after the first operation had degenerated (Fig. 21).

This case also illustrates yet another complication—narrowing of the disc after a protrusion has been removed. The original roentgenogram of this patient showed nothing abnormal, but at the time of the second operation the lumbosacral disc was a little narrowed. Three months after the second operation the lumbosacral disc was attenuated, and there was subluxation of the lateral joints at this level and a little backward displacement of the fifth lumbar vertebral body. Subsequent

roentgenograms showed progressive narrowing of the disc (Fig. 22). This patient continues to have pain, now less severe than before the recurrent protrusion was removed, but it is likely to become progressively worse.

Postoperative narrowing of the disc space is, of course, a significant finding, the mechanical result of acquired narrowing being posterior displacement of the upper vertebral body, subluxation of the lateral joints between the two bodies, and constriction of the intervertebral foramen.

At the present time we have been able to obtain late postoperative roentgenograms of only 17 of our disc cases (including the case illustrated in Fig. 22). The preoperative roentgenograms in each of the 17 cases were normal. In 10 of these cases, however, the late postoperative roentgenograms show degenerative changes, as follows:

In 4, the disc operated upon has become narrow.

In 5, there is narrowing of the disc operated upon, and also narrowing of an adjacent disc (Figs. 23-26).

In 1 case there is narrowing of the disc operated upon, and of two other discs, in addition (Fig. 27).

It is clear, therefore, that progressive postoperative degeneration of one or more discs is by no means uncommon. This fact must be considered in planning the treatment in these cases. The object of the operation should be, not only to relieve the pressure on a nerve root, if indeed any root is being pressed upon, but also to avoid ill effects from the subsequent degeneration which may be expected.

SELECTION OF CASES FOR OPERATION

There is no doubt that cases with abnormal neurological signs indicating pressure on a nerve root and interference with conduction in the root give better immediate results than those in which the pain is of a referred type, without any interference with conduction. Those with abnormal neurological signs recover more quickly and more completely. The immediate relief from severe pain is striking. When there is no loss of conduction the immediate results are often disappointing. The pain is at first only partially relieved and recovery, which progresses slowly over a period of months, may in the end be incomplete.

These observations raise the question of the type of operation to be performed.

1. When a protrusion is to be removed, a laminectomy with ample bone removal and wide exposure is advisable.

2. If there is no protrusion, but the disc is degenerate, it was for some time our custom to complete the operation as an arthrectomy, and to remove the lateral joint. This operation "decompresses" the nerve root and, as a rule, gives satisfactory results. In some cases of this sort, however, spinal fusion has been done, i.e., when the presence of degeneration without protrusion has been verified, an Albee graft is applied, the laminae and lateral joints being left intact. This procedure seems rational, the fusion being intended to protect the degenerated disc from further strain or injury. Further observation will determine its value.

3. For cases with arthritic changes in the lateral joints, confirmed by roentgenography, arthrectomy is the operation of choice. These changes are usually found in patients in the fifth or sixth decades.

When the laminae have been exposed in the approach to the joints, it is advisable to explore the interlaminar spaces to make certain that the discs are normal before the joints are excised.

SUMMARY

1. A modern tendency to overemphasize the importance of the prolapsed intervertebral disc as a cause of sciatica is noted.

2. The nature of sciatic pain is analyzed with particular attention to the importance of referred pain.

3. The clinical characteristics, diagnosis, and differential diagnosis of sciatica are discussed.

4. The article is based upon a study of 298 cases of sciatica.

I wish to record my gratitude to Mr. Blundell Bankart and to Mr. Philip Wiles for so kindly placing their case records at my disposal, and to Miss Muriel Crouch for her expert help in the preparation of this article, and in the treatment of many of the cases recorded in it.

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ABSTRACTS OF CURRENT LITERATURE

SURGERY OF THE HEAD AND NECK

EYE

Lee, Otis S., Jr.: Corneoscleral Suture in Operations for Cataract, with Special Reference to the Incidence of Postoperative Hyphema. *Arch. Ophth.*, Chic., 1947, 37: 591.

Recent investigations have shown that the source of postoperative hemorrhage into the anterior chamber is from the new blood vessels that are growing into the incision. Any separation of the lips of the wound tears these vessels and results in bleeding under the conjunctiva or, more frequently, into the anterior chamber.

The purpose of this article is to compare the occurrence of postoperative anterior chamber hemorrhage in those patients who have had three or more interrupted limbic-episcleral sutures for the closure of the incision with such occurrence in patients who have had a modified Liégard suture with 2 additional limbic-episcleral sutures. In placing this modified Liégard suture the globe is fixed with a Burch pick which is placed opposite the point at which the needle is to penetrate the corneal tissue. A bite is taken in the limbus at twelve o'clock, parallel to the limbus and from 1.5 to 2 mm. wide. The thread is pulled through until it is stopped by a previously prepared double knot about 3 cm. from the end. The needle is reversed and, with fixation, is transferred to the opposite side. A bite is taken from 1.5 to 2 mm. above the first one, the needle passing through the conjunctiva and scleral tissue and out again. The scleral bite is equal in width, and lies exactly opposite, to the limbic suture.

In the first 150 cases from 3 to 5 interrupted limbic-episcleral sutures were used; in one half of this series a complete iridectomy was done, whereas in the other half only a small peripheral iridotomy was done. No significant difference in the number of hemorrhages into the anterior chamber was found between these two groups. In the next series of 150 cases a modified Liégard stitch was used in addition to the interrupted corneoepiscleral sutures. In this group all cataracts were extracted through an intact sphincter pupillae with a small peripheral iridotomy performed in each case. A comparison showed an incidence of postoperative hyphemia in 15.3 per cent of the first series and in 6.6 per cent of the second series in which the modified Liégard suture was used. In the second series the bleeding was less severe.

The author postulates that the poor results with the interrupted limbic-episcleral sutures may have been due to the fact that many were limbic-conjunctival rather than episcleral and therefore unable to hold the wound in as close apposition. The modified Liégard suture is preferred since it is easy to place, requires no conjunctival flap, may be quickly closed, and may be used to open the wound for the insertion of instruments. Care should be taken that the horizontal bites are placed opposite each other and that the sutures are not tied too tightly.

ROGER H. JOHNSON, M.D.

Owens, William Councilman; and Hughes, William F., Jr.: Intraocular Hemorrhage in Cataract Extraction. *Arch. Ophth.*, Chic., 1947, 37: 561.

The authors reviewed 2,086 extractions of uncomplicated senile cataract to determine what factors in the patient's physical status or in the operative technique produced intraocular hemorrhage, how these factors could be controlled, and what effect each type of hemorrhage had on the postoperative course and visual result. Three types of intraocular hemorrhage were evaluated in this study. Postoperative hemorrhage into the anterior chamber occurred in 9.3 per cent of the cases; 3.6 per cent of these were designated as severe because the hemorrhages either filled the anterior chamber completely or were recurrent. The most frequent time of onset was between the second and the sixth days. The age, blood pressure, and prothrombin levels had no relationship to the postoperative hemorrhage.

The diabetics as a group showed only a slight increase in the tendency toward postoperative hyphemia; however, diabetics of long standing or who required large amounts of insulin showed a sharp increase in the incidence of severe hemorrhage. The blood sugar level or presence of central retinitis made no difference in the incidence of postoperative hemorrhage. Syphilis and the presence or absence of foci of infection had no bearing.

The type of extraction had no effect on the number of hemorrhages but both the use of 2 corneoscleral sutures and a shallow section reduced the incidence considerably. There was a very slight increase in the incidence of postoperative hemorrhage into the anterior chamber following full iridectomies, and a progressive increase in hemorrhages with the loss of increasing amounts of vitreous. No relationship was found between postoperative hemorrhage and the visible gaping of the wound, delayed reformation of the anterior chamber, prolapse of the iris, or iridocyclitis. The authors believed that the bleeding resulted from the rupture of the small capillaries that had grown into the healing incision.

The major cause of the significantly poorer visual results in cases of postoperative hemorrhage into the anterior chamber was found to be due to seepage of blood into the vitreous with its resultant opacities.

Postoperative hemorrhage did not predispose to late secondary glaucoma or phthisis bulbi. Blood remained more frequently in the anterior chamber at the end of the operation, because of unusually severe bleeding, in older patients and in patients in whom the sections had been placed more deeply, and had no effect on the visual results.

In this series there were 3 expulsive hemorrhages which the authors did not believe were related to the blood pressure. ROGER H. JOHNSON, M.D.

Yasuna, Elton R.: Danger of Penicillin Therapy in Active Uveitis. *Arch. Ophth.*, Chic., 1947, 37: 598.

Since even following massive doses only negligible amounts of penicillin reach the aqueous, vitreous, and lens by intravenous, intramuscular, and oral routes, other methods of administration have been employed in opthalmology. Application directly to the cornea and conjunctiva gives excellent concentrations on the anterior surface of the globe. The use of iontophoresis, wetting agents, and cotton packs saturated with penicillin and placed in the lower fornix has proved a satisfactory and convenient method of obtaining higher levels in the cornea, aqueous, iris, and ciliary body. Penicillin has been found to be excellent in the treatment of ophthalmia neonatorum and to be a therapeutic aid in both acute and chronic trachoma; however, reports by various authors on the value of penicillin in the treatment of infectious conditions of the inner eye have not been in agreement.

The author cites 2 cases of acute iridocyclitis, one a recurrent type and the other following traumatic surgery, which were treated by the usual methods in addition to small intramuscular doses of penicillin. Both cases became progressively worse but on cessation of the penicillin therapy showed rapid improvement. Recent investigations have tended to show that a uveitis may be caused by a hypersensitivity of the eye to the bacterial products emanating from the primary focus of infection rather than to bacteria lodging in the uvea. Penicillin is generally agreed to be not only bacteriostatic but also bacteriocidal. The author suggests that the use of penicillin kills bacteria in the foci and releases more bacterial end products into the blood stream. This increases the amount of bacterial toxins in the blood stream and thereby increases the already active uveitis. By stopping the penicillin and thereby stopping the breakdown of the bacteria, the uveitis could improve.

Since most observers believe that penicillin is not of value in uveitis, the author thinks that it would be more advisable not to employ the drug, especially when it may actually be dangerous.

ROGER H. JOHNSON, M.D.

Zondek, H., and Wolfsohn, G.: Glaucoma and Pituitary Function. *Am. J. Ophth.*, 1947, 30: 596.

The authors discuss the relationship between primary glaucoma and the pituitary-diencephalic system. They point out that endocrine factors such as the thyroid, pituitary, gonads, and the corticoadrenal system have been considered as possibly responsible for primary glaucoma. A similar relationship between a number of other ocular diseases (retinitis pigmentosa, the Lawrence-Moon-Biedl syndrome, pituitary-diencephalic exophthalmos, etc.) and the pituitary body (the diencephalic pituitary system) has been established.

In a series of 22 cases of primary glaucoma, tests were made of the carbohydrate and water metabolism, basal metabolism, blood cholesterol, and of the osseous structure of the skull. Of these, 16 cases presented evidence which indicated disturbances in the pituitary-diencephalic system: obesity, menstrual disturbances, disordered carbohydrate metabolism, water retention, abnormal basal metabolic rates, elevated blood cholesterol, decalcification or atrophy of the sella turcica (occasionally calcification), and congestion of the meningeal vessels. Six of the 16 patients presented pituitary tumors, and 2 of these presented characteristics of acromegaly.

Only 6 of the total number of 22 cases presented no evidence of pituitary-diencephalic disturbances.

The authors suggest the term "pituitary diencephalic glaucoma," to correspond with the accepted term, "pituitary-diencephalic exophthalmos," to designate those cases of primary glaucoma which present pituitary-diencephalic symptoms.

JOSHUA ZUCKERMAN, M.D.

Reese, A. B.: Pigmented Tumors. *Am. J. Ophth.*, 1947, 30: 537.

The author discusses pigmented tumors. Melanoblasts produce pigment called melanin. Because little is known about these cells and their product, great differences of opinion exist regarding them.

The term "melanin" is applied to any black, brown, or tan pigment, and any heterogeneous group of pigments which possess the common characteristic of absorbing visible light uniformly.

There are various types of melanoblasts from which various types of tumors arise.

Ophthalmologists encounter nevi of the skin, of the eyelids and, more commonly, of the conjunctiva, particularly at the limbus and caruncle.

Nevi are congenital, but are not visible at birth. They grow during the first decade of life and become pigmented between the ages of 4 and 14 years, especially at puberty, at which time they are usually noticed first. They regress in later life and occasionally disappear spontaneously and completely. A nevus can develop into a malignant tumor, but this occurs very rarely.

It is pointed out that pigmented tumors seem to differ genetically, histologically, and clinically, but all have one factor in common—pigment. The pigment is so conspicuous that it dominates the histologic and clinical picture. The author believes that instead of diagnosing all tumors which harbor pigment as "melanomas" they should be designated by terms which connote their separate entities. He suggests the following terminology: (1) benign and

malignant neurogenic melanoma, arising from the Schwann cell and the nerve cell; (2) benign and malignant neurogenic melanoepithelioma, from the pigment epithelium of the retina and ciliary body; (3) leiomyoma, from the dilator and sphincter muscles of the iris; (4) dictyoma, from the pigment epithelium of the iris; (5) precancerous and cancerous melanosis, from the basal layer of epithelium; and (6) benign and malignant chromatogenic melanoma, derived from the mesodermal chromatoblasts (uvea, sacral and extrasacral mongol spots).

JOSHUA ZUCKERMAN, M.D.

Roper-Hall, M. J.: Research in Zurich. *Brit. J. Ophth.*, 1947, 31: 223.

This article gives a summary of the work on the pathological changes in the aqueous humor and the blood-aqueous barrier carried on at Zurich. The specimen of aqueous was obtained with a special needle attached to a tuberculin syringe which enters the anterior chamber on a plane parallel to the iris and at a point about 3 mm. from the limbus. A smear and culture were first taken from the conjunctival sac and a small scraping of corneal endothelium was removed from the point at which the puncture was to be made.

On the 0.2 c.c. of fluid obtained a study was carried out, including quantitative tests for albumin (Pandy reaction), cell count, cultures, and microscopic examination of the centrifuged material with various stains. The conjunctival and epithelial smears were examined and conjunctival cultures were correlated with the aqueous findings. More than 1,900 punctures were performed in the course of this research. The following findings were noted:

1. The normal aqueous contains from 0 to 1 cell per cubic millimeter.

2. The number of cells increases in cases of anterior uveitis and deep corneal ulcer, usually to between 30 and 200 cells, but in a few cases up to 100,000 cells per cubic millimeter.

3. In acute inflammations the albumin is increased in proportion to the number of cells.

4. In chronic inflammations there is a dissociation between the albumin and the cell count as observed in the pathology of the cerebrospinal fluid.

5. Study of the morphology and origin of the cells indicates that the cells are derived from the blood and neighboring tissues.

6. The presence of microphages and macrophages in the specimens indicates the phagocytic and antitoxic function of the desquamated cells.

7. Of the 651 cases of endogenous and exogenous iridocyclitis, keratitis, and panophthalmitis, 19 per cent showed large reticuloendothelial cells which had phagocytized micro-organisms, thought to be staphylococci in most cases. Tubercle bacilli were found in only 1 case. Cultures are rarely positive (20 cases in the series).

8. The presence of micro-organisms in the anterior chamber in cases of iritis and keratitis may throw light on the etiology.

9. The absence of tubercle bacilli may throw some doubt on the importance of their role in the etiology of uveitis.

10. The type of organism found indicates the possibility of focal infections.

Studies on the blood-aqueous barrier were carried out with the intravenous injection of fluorescein and studies of the aqueous with an adapted slit lamp. Investigation of 200 normal eyes showed that there is a regular and gradual rise of fluorescein in the anterior chamber with the normal for children slightly higher than that for adults. After examining 1,000 cases by this method it was concluded:

1. In iridocyclitis there is an increase in permeability which corresponds to the severity of the disease.

2. In glaucoma there may be a normal or considerable increase in permeability, perhaps indicating the etiology.

3. Ocular affections and trauma cause an increase in permeability, as well as some general diseases such as chronic nephritis, hepatitis, and especially diabetes.

4. Pilocarpine increases the permeability, atropine has no effect, and adrenalin decreases it.

Studies of the Tyndall effect suggest that it shows the permeability of the damaged blood-aqueous barrier to proteins and large molecules, while the fluorescein permeability shows the more minute change in the wall to small particles.

WILLIAM A. MANN, M.D.

EAR

Mohs, F. E.: Chemosurgical Treatment of Cancer of the Ear; A Microscopically Controlled Method of Excision. *Surgery*, 1947, 21: 605.

This article deals with the chemosurgical treatment of cancer of the ear and includes an analysis of the therapeutic results in a consecutive series of 107 lesions treated over a period of 9.25 years. Inasmuch as the behavior of squamous cell carcinoma is much different from that of basal cell carcinoma, the two histologic types are considered separately except in regard to the chemosurgical technique which is the same for both types.

The chemosurgical technique by which cancer of the ear may be excised under systematic microscopic control is described in detail.

The rates of cure in the series of patients with squamous cell carcinoma of the ear were: 80 per cent at 6 months or more, 74.2 per cent at 3 years or more, and 64.3 per cent at 5 years or more. The primary lesion was eradicated in 92 per cent of the patients.

The rates of cure in the series of 55 patients with basal cell carcinoma of the ear were: 92.2 per cent at 6 months or more, 87.1 per cent at 3 years or more, and 81 per cent at 5 years or more.

The reliability and the conservatism of the method are both due to the systematic microscopic control of excision afforded by the chemosurgical technique.

JOHN F. DELPH, M.D.

NOSE AND SINUSES

Spar, Arthur A.; and Hallberg, Olav E.: Severe Epistaxis and Its Management; Report of 11 Cases in Which the External Carotid Artery was Ligated. *Ann. Otol. Rhinol.*, 1947, 56: 141.

Since 1930, 106 cases of epistaxis have been treated in hospitals connected with the Mayo Clinic Of all the patients studied, approximately 40 per cent had either hypertension or arteriosclerosis, or both, which had been previously diagnosed. Forty per cent of all the patients were more than 60 years of age. Of those past 60 years, 60 per cent had hypertension. In 29 cases presenting no obvious cause of hemorrhage or previous diagnosis of cardiovascular disease, the epistaxis was classified as of undetermined cause. In nearly all of these, however, the patients were in the age group in which cardiovascular disease is common.

Most textbooks dismiss the anterior portion of the septum as being of only nuisance value, but half of the total number of these patients requiring hospitalization bled from this source. It is not surprising to those who routinely have to treat nosebleed that anterior septal bleeding can be so severe as to require hospital apparatus for its control. Three of 5 patients more than 60 years of age bled from this source.

Nearly a third of all patients bled from a point high and posterior in the nose, most of these from the sphenopalatine artery. Trauma incidental to packing the nose prior to hospitalization was found to be a considerable factor in the cases classified as bleeding from the turbinates or diffusely from the nasal membranes.

On admission to the hospital, the patient is examined first for symptoms of shock and for active bleeding. If he is an adult he is given from 1/6 to 1/4 gr. (from 0.01 to 0.016 gm.) of morphine by hypodermic injection. With close observation of the patient, it is not difficult to distinguish between shock due to hemorrhage and the shocklike appearance of a patient who is nauseated from swallowing too much blood. If there is uncertainty as to the condition of the patient, there need be no hesitancy in giving him a transfusion of blood. Liters of group O blood should be available for immediate use.

If the hemorrhage is controlled by packs inserted elsewhere prior to hospitalization, the packs are left in place and the patient is watched thereafter for recurrence of bleeding.

If there is active bleeding, all packs are removed and the nose is quickly cleaned with a suction apparatus under direct vision to determine the source and severity of the bleeding. Cotton pledgets moistened in equal parts of a 1:1,000 solution of epinephrine chloride and a 10 per cent solution of cocaine are then used to shrink the nasal mucous membrane and provide local anesthesia for any necessary instrumentation. A length of 1 inch (2.5 cm.) gauze heavily covered with vaselin is robably the most useful agent available to the rhinologist for the control of nasal hemorrhage. Large spurting vessels do not respond to the chemical cautery, and high posterior spurting vessels are inaccessible to the electrocoagulating point. A short strip of vaselin gauze, carefully and firmly packed over the bleeding point, controlled hemorrhage in 80 of the cases of nosebleed.

There should be no hesitancy about inserting a postnasal pack if the anterior packing alone fails to stop the flow of blood. Chemoprophylaxis or antibiotics are routinely used in cases in which posterior packing is required.

Eleven patients failed to respond to conservative treatment and required ligation of the external carotid artery. Two of these developed minor wound infections and a third needed tracheotomy because of laryngeal edema from wound infection.

MOUTH

Osácar, Ernesto Martín: The Mirault-Blair-Brown Operation on the Unilateral Harelip (The Flap Operation) (La operación de Mirault-Blair-Brown en el labio leporino unflateral). *Bol. Soc. cir. Cordoba*, 1946, 7: 436.

Types of unilateral harelip include: (1) partial, when the mucous membrane and border and adjacent skin only are involved; (2) subtotal, when the cutaneous part of the lip is involved; and (3) total, when the entire lip, nasal passages, and the gingival arch are affected.

Good surgical results must obtain the following: (1) symmetrical overhanging ala; (2) symmetry of the nasal passage and columella; (3) a satisfactory base for the nose; (4)maintenance of normal curvature of the nose; (5) a precise columella, (6) normal curvature of the upper lip, and (7) even and properly proportioned mucosal and vermilion borders.

Steps of the subtotal and total harelip operations are given in detail with the cardinal points emphasized and illustrated.

The authors advocate surgical repair within the first 48 hours as the complications of the malformation are more easily avoided. Postoperative management must be assiduous. Nonabsorbable sutures are removed in from 4 to 6 days. Food is given from the first hours according to the patient's tolerance. Local anesthesia is preferred although some workers use ether. STEPHEN A. ZIEMAN, M.D.

Seeley, R. C.: Maxillofacial Injuries. Reconstructive Surgery of the Dehiscent Parotid Duct and Dehiscent Peripheral Facial Nerve. *Am. J. Surg.*, 1947, 73: 551.

The purpose of this article is fourfold: to bring up to date the work done on parotid duct injuries; to review the literature to the date on the associated facial nerve injuries; to report a case; and to present a logical surgical technique in the repair of maxillofacial injuries resulting in lacerations, obstructions, or dehiscences of the peripheral facial nerve and parotid duct.

One of the least commonly stressed injuries about the face is parotid duct injury, particularly when the injury results in the dehiscence of the duct. Such an injury would necessarily be predicated upon a similar injury to the peripheral facial nerve. This article deals primarily with the secondary repair of the dehiscent parotid duct, dehiscent zygomatic branch of the facial nerve, and repair of the buccal branch. The technique employed is one that can be utilized in either primary or secondary repairs.

In retrospect, duct injuries have, for the most part, been considered quite separately with regard to methods of repair and these usually have been emphasized under two headings: (1) the immediate repair, and (2) repair of the duct with existing fistulas. With reference to the seventh nerve peripheral injuries, these, too, have been considered for the most part as separate entities, notably by Furstenberg and Bunnell.

It is the contention of the author that, while many cases of separate injury of the duct and facial nerve exist in consequence of injuries of a type, it is more than likely that if parotid duct injury exists peripheral nerve injury is also present, and vice versa. If a lacerating, penetrating, or avulsion injury involves the parotid duct, the buccal and zygomatic branches of the facial nerve will be involved.

The author believes that it is not necessary to convert external fistulas into internal fistulas as a method of repair, and that it is practicable to explore, isolate, resect, and anastomose by primary suture as a method. That is better surgery in view of the nerve factors present. The author's case, after pathological resection and excision 43 days subsequent to the primary injury, was successfully repaired despite the existence of a 30 mm. dehiscence of the duct proper and a 30 mm. dehiscence of the zygomatic branch of the facial nerve. An indwelling No. 30 alloy steel wire dowel, which can be carried out through the cheek with no residual evidence of a puncture wound externally, is a dowel of new material which is unsurpassed in reducing capillary and surface tension factors.

The successful repair in the case presented should nullify the opinions of those who elect to extirpate the parotid gland or destroy it by radiation when obstruction or fistulas exist. JOHN F. DELPH, M.D.

Friedman, G. A.: Tracheotomy in Maxillofacial Surgery. *Surgery*, 1947, 21: 755.

Severe maxillofacial wounds are often associated with other injuries and associated neck injury is especially important in this connection. Three questions must be answered: How much can be done? How shall it be done? How best can it be done?

The causes for acute respiratory obstruction, such as hemorrhage into the air passages, edema of the aryepiglottic fold, and foreign bodies, are enumerated as well as the signs of acute respiratory obstruction.

In war surgery the primary concern is indication for tracheotomy when respiratory obstruction is not yet present but diagnosis leads one to believe that it will ensue.

Among the causes are: injuries to the base of the tongue, pharynx, or larynx, with or without the presence of foreign bodies; large foreign bodies in the air passages which cannot be removed under direct vision: extensive soft tissue wounds of the face which may cause later destruction by the spread of inflammation to the mucous membranes of the air passages; extensive fractures of the mandible situated where the tongue cannot be held forward by mechanical means; extensive injury to the upper facial regions, especially when these close off the nasal passage completely; and severe fractures of several of the upper facial elements.

Postoperative inflammation may descend to involve the pharynx and subsequently the mucous membranes of the air passages. Injury to the recurrent laryngeal or the vagus nerve by direct trauma or by pressure from hemorrhage may cause paralysis of both cords if bilateral, and extreme dyspnea may ensue.

Eleven cases are reported in detail with a description of the procedure accompanied by photographs.

Among other conclusions, the author states that horizontal incision of the skin is the natural and best one for tracheotomy. JOHN F. DELPH, M.D.

NECK

Lahey Frank H., and Bartels, Elmer C.: The Use of Thiouracil, Thiobarbital, and Propylthiouracil in Patients with Hyperthyroidism. *Ann. Surg.*, 1947, 125: 572.

The authors prepared 660 patients for surgery with thiouracil, thiobarbital, or propylthiouracil during a 3.5 year period. In addition, 21 cases were treated over a long period of time without surgery. These compounds in adequate dose prevent synthesis of inorganic iodine into diiodotyrosine and thyroxine; the protein bound iodine decreases and the basal metabolism rate drops. In time myxedema may result. The microscopic appearance of the hyperplastic gland is not changed by these agents. The metabolic rate returns to normal with adequate dosage. The usual daily doses required are 600 mgm. of thiouracil, 50 mgm. of thiobarbital, or 200 mgm. of propylthiouracil. (The original suggested dose, from 75 to 125 mgm. of propylthiouracil, has been found too small). With the above doses, the basal metabolism rate decreases 1.3 per day in patients having primary hyperthyroidism for less than 9 months, without iodine therapy. If iodine has been taken, or if hyperthyroidism has been present longer than a year, irrespective of iodine, the daily decrease in the basal metabolism rate is 1. With toxic adenomas, especially if iodine has been given, the decrease may be as slow as 0.5 daily. The longest time required was 180 days. The incidence of complications was 28 per cent with thiobarbital, 9 per cent with thiouracil, and 2 per cent with propylthiouracil. With propylthiouracil and with thiobarbital, only

blood cell depression and fever have been observed; with thiouracil there were white blood cell depression, fever, skin rash, swollen salivary glands, edema of the skin, and 1 death with agranulocytosis. The authors believe the use of thiobarbital should be abandoned.

In managing their patients, the authors require a white blood count every 10 to 14 days; when the white cells decrease below 4,500 and when the granulocytes are below 45 per cent, administration of the drug is stopped or continued very cautiously. Treatment of agranulocytosis requires the use of penicillin to prevent or cure infection, which is the cause of death. No benefit from pyridoxine or liver extract was seen in these patients. The penicillin is given intramuscularly and by throat spray.

Because of the increased vascularity and friability of the gland resulting from simple thiouracil, thiobarbital, or propylthiouracil treatment, with resulting difficulty in the surgical removal of the gland, iodine is now given from the beginning of treatment and administration of the thiocompound is stopped 7 days before surgery. The 7 day period was chosen because agranulocytosis has been observed as late as 7 days after cessation of drug administration. This avoids agranulocytosis as a complication at the time of operation.

Iodine therapy is not used in patients with adenomatous goiters.

Surgery should be done with the patient in as nearly normal a state of metabolism as possible. If myxedema occurs before surgery, there is danger of too great edema of the larynx and of too great sensitivity of the respiratory center to morphine; tracheotomy had to be used once in such a situation.

There were 115 thyrocardiac patients and 26 diabetics among the 660 patients treated with thiocompounds. The new treatment has reduced the previous surgical mortality of 6.7 per cent among thyrocardiac patients to 0.87 per cent. The 1 fatality among the thyrocardiacs was the only death among the 660 cases, an over-all mortality of 0.15 per cent. A variety of complicating diseases were present, including recurring gallstone colic and thrombocytopenia. The thyroid condition was treated first, then the complication.

An attempt was made to treat primary hyperthyroidism by medical means alone in 21 cases. Treatment varied from 2 to 20 months before remission occurred. After the thiouracil was stopped, 13 of the 21 cases presented a relapse. All of the 8 patients still in remission had mild cases. The authors believe that severe cases will always require surgery, but that there is still a basis for hope that mild cases may be cured or permanently controlled by medical means. CLINTON H. THIENES, M.D.

Penick, Rawley M., Jr.: The Use of Thyroid Extract with Thiouracil in the Preparation of the Thyrotoxic Patient. *Ann. Surg.*, 1947, 125: 582.

The authors attempted to prevent hyperplasia of the thyroid with thiouracil as they thought there was some danger of promoting cancerous change, especially since invasive tumors in animals have been produced by simultaneous administration of thiouracil and a carcinogen. Since thiouracil hyperplasia is believed to be due to an increased secretion of pituitary thyrotropin, which in turn is due to the decreased amount of thyroxin in the circulation, the author gave 64 mgm. of desiccated thyroid along with 0.6 gm. of thiouracil to 6 patients with exophthalmic goiter. The preoperative course was similar to that in patients given thiouracil and iodine; there was satisfactory involution of the gland with accumulation of colloid. The vascularity in 3 of the cases was equal to that in thiouracil-iodine treated patients and in 3 was thought to be slightly greater.

The author believes that desiccated thyroid is a satisfactory adjunct to thiouracil for preoperative preparation of thyrotoxic patients.

CLINTON H. THIENES, M.D.

Morgans, M. E.: Toxic Effects of Thiourea, Thiouracil, Methyl Thiouracil, and Aminothiazole in Thyrotoxicosis. *Lancet*, Lond., 1947, 1: 519.

A series of 92 patients with thyrotoxicosis were treated with thiourea (7), thiouracil (49), methyl thiouracil (23), and aminothiazole (13), to determine the toxic effects of these drugs during the initial phases of treatment.

A table is presented in which the effect of these 4 thiourea drugs on the granular cells during the first 3 weeks of treatment is shown. The greatest decrease occurred at the end of the first week and in the methyl thiouracil series. With aminothiazole, the granular cell count was halved during the first 3 weeks and in 38 per cent of the cases the absolute granular cell count was lowered more than 1,000 per cubic millimeter from initial levels.

A comprehensive incidence of complications is shown in a table for these drugs and the dosage used during the first 2 months of treatment. Methyl thiouracil and thiouracil produce a decrease of the white cells and in some cases leucopenia, but the incidence of other dosage effects is very low. From the author's point of view, thiourea and aminothiazole have many toxic effects and their clinical use is no longer justifiable.

RICHARD J. BENNETT, JR., M.D.

Williams, R. H., Asper, S. P., Jr., Rogers, W. F. Jr., Myers, J. D., and Lloyd, C. W.: Persistence of Remissions of Thyrotoxicosis after Cessation of Thiouracil Therapy. *N. England J. M.*, 1947, 236: 737.

Of 111 thyrotoxic patients who were treated with thiouracil and had a cessation of therapy, 51 are in remissions that have lasted for 3 to 31 months. Forty-four patients have been free of thyrotoxicosis for more than a year after cessation of therapy, and 33 have remained well for more than 18 months. Of all the patients who remained well without treatment for more than a year, only 1 had a relapse. Following the cessation of treatment with thiouracil, most of

the patients who had a relapse had it within a few months; 70 per cent had it within 2 months, and 88 per cent within 5 months.

Factors that have tended to favor persistent remissions were as follows: female sex, small goiter, and a mild degree of thyrotoxicosis. The age of the patient, the duration of the disease, and the nodularity of the thyroid gland were not found to exert a significant influence, but these factors may prove important when larger series of cases are analyzed.

The good effects obtained with thiouracil encourage the frequent use of its less toxic derivative, 6-propylthiouracil, in the treatment of thyrotoxicosis. This therapy, radioactive iodine, or a combination of the two, appears to offer the most satisfactory method of treating the majority of patients with thyrotoxicosis, but further experiences may reveal complications from these types of treatment that are of greater magnitude than are anticipated at present. Therefore, patients treated by these newer methods must be followed carefully.

Arendt, J., and Wolf, A.: The Vallecular Sign; Its Diagnosis and Its Clinical Significance. *Am. J. Roentg.*, 1947, 57: 435.

The "vallecular sign" consists of the retention of barium mixture during the swallowing act in the pockets of the valleculae and in the pyriform sinuses. The findings have been such that they might be taken as a differential diagnostic sign pointing to organic disease. This sign has been observed in bulbar paralysis, myasthenia gravis, carcinoma of the cardiac end of the stomach, carcinoma of the hypopharynx, suspected paramediastinal lung tumor, perforating carcinoma of the esophagus, and a case of abnormal origin of the right subclavian artery with clinical symptoms of dysphagia lusoria.

Eight cases are presented in detail along with 17 figures. The presence of the "vallecular sign" points to an organic lesion and not to a functional type of dysphagia. RICHARD J. BENNETT, JR., M.D.

Lahey, Frank H.: Parathyroid Tumors. *Surg. Clin. N. America*, 1947, 27: 477.

There are four types of parathyroid tumors: (1) discrete nonhyperfunctioning adenomas of the parathyroid; (2) cystic degeneration within such an adenoma producing a cyst of the parathyroid; (3) hyperfunctioning parathyroid adenoma, and (4) localized malignancy in the neck arising from a parathyroid gland.

In patients with clinical signs of hyperparathyroidism on whom an operative procedure must be performed to discover the hyperfunctioning parathyroid adenoma, it is of the utmost importance to be familiar with the appearance and probable location of the normal glands. In most cases 4 parathyroid glands are present, 2 at the upper and 2 at the lower pole. The glands at the upper pole are usually situated at the point where the upper lobes of the thyroid rest against the larynx, in relation particularly to the horn of the thyroid cartilage. To demonstrate these glands it is usually necessary to ligate the superior thyroid artery and roll the superior pole of the thyroid downward and inward. The inferior parathyroids are more difficult to demonstrate; their frequent location within the branches of the inferior thyroid artery and vein makes the necessary bloodless dissection difficult. Also, at this location fat as well as lymphoid and thymic tissue can easily be confused with parathyroid tissue.

Anomalous positions of the glands are quite common; parathyroid glands have been found on the anterior surface of the thyroid, within the substance of the thyroid gland, beneath the clavicle, and in the mediastinum. The normal parathyroids vary in size from structures not much larger than the head of a match up to those the size of a pea or bean. They usually have a distinctive light mahogany, yellowish brown color. Another distinctive feature of the parathyroid glands is their flat disclike shape. In the presence of a hyperfunctioning adenoma the remaining normal glands may be quite inactive; such glands are filled with fat, are pale in color, and do not look like normal parathyroids. In the event that the hyperfunctioning adenoma is not readily found, it is of great value (if possible) to identify the 3 normal glands in order to have definite indications as to the location of the adenoma. It must not be forgotten that on occasion the hyperfunctioning adenoma is within the substance of the thyroid gland.

The diagnosis of hyperparathyroidism, when it is present in a well developed state, is not difficult; the presence of varying degrees of decalcification of the bony skeleton, and the typical blood chemistry changes of high calcium, low phosphorus, and high phosphatase blood values are diagnostic. However, the diagnosis of hyperparathyroidism should not be delayed until pronounced decalcification has taken place. Any evidence of bone rarefaction, spontaneous fracture, and kidney stones should arouse suspicion of this disease. Calcium excretion in the urine can be simply estimated by means of the Sulkowitch test; 2 c.c. of acid urine are mixed with an equal amount of Sulkowitch reagent and the turbidity read qualitatively.

Attention is called to the danger of tetany following the surgical removal of a hyperfunctioning adenoma. Also, while recalcification is progressing during the postoperative period, orthopedic support in proper positions may be necessary so that the recalcification does not exaggerate the positions of deformity. F. J. LESEMANN, JR., M.D.

Goldberg, H. M.: Carotid Body Tumors. *Brit. J. Surg.*, 1947, 34: 295.

Two detailed case reports of rare carotid body tumors with survival and without complications after ligation of the common carotid artery are presented. A review of the subject is discussed.

The carotid body is inconstant in man and when present is situated behind the common carotid artery at its bifurcation.

Extirpation or absence of the carotid bodies has no adverse effect.

Tumors constitute the only pathological lesion of the carotid body. About 265 cases have so far been reported. They are slow growing tumors, usually benign at first, but they may become malignant later.

The majority of tumors arise from the epithelial type of cell. Two patterns, the alveolar and the pertheliomatous, have been described.

Tumors of the carotid body occur with equal frequency in both sexes. Both sides are equally affected. The average age of the patients is 43.2 years.

The most frequent history is that of a painless unilateral slow growing tumor in the neck. Rarely the tumor is sensitive to touch, but it is never painful. Other symptoms are due to compression or invasion of the surrounding structures. These are not frequently encountered. Hoarseness, dyspnea, dysphagia, cough, and tinnitus may be due to compression of the vagus. Horner's syndrome, due to pressure on the cervical sympathetic, and earache due to involvement of the cervical plexus have been reported. Fainting attacks are due to the coexistence of a sensitive carotid sinus.

Overactivity of the carotid sinus reflex has been associated with a carotid body tumor in 5 of 260 cases found in the literature and in 1 case of the author's. The nerve supply of the sinus is similar to that of the carotid body, being derived chiefly from the glossopharyngeal nerve by way of the carotid sinus nerve of Hering, and probably also from the vagus, hypoglossal, and the sympathetic nerve. A tumor of the carotid body may, therefore, occasionally produce an overactive sinus by 2 mechanisms, either by direct pressure or by way of a reflex arc. Other lesions in the neighborhood of the bifurcation of the common carotid, such as cervical lymphadenopathies (chiefly tuberculous) are very occasionally associated with a hypersensitive sinus.

Carotid sinus syncope can be precipitated in subjects with a sensitive sinus by a sudden turning of the head, wearing tight collars, or by pressure over the sinus. It is characterized by pallor, hyperpnea, muscular twitching, and dizziness, followed by unconsciousness. Flushing of the face occurs on recovery. Two types of carotid sinus syncope are recognized, according to which of the 2 efferent pathways, the vagus or the vasomotor depressor nerves, predominates.

In the cardioinhibitory type, in which vagal cardiac inhibition is the predominant factor, a marked fall in the blood pressure is associated with complete asystole or ventricular standstill. The electrocardiogram during the attack shows no alteration of potential or only a succession of P waves. This reaction can often be prevented by atropine.

In the vasodepressor type, vasodilatation causes a fall in the blood pressure and the consequent cerebral anemia results in unconsciousness. The cardiac rate does not slow markedly and vagal stimulation of the heart produces at the most nodal escape, so that the electrocardiogram shows either no alteration from normal or absent P waves. This type may often be relieved by sympathomimetic drugs such as ephedrine or benzedrine.

The electroencephalogram shows moderate to highvoltage slow (delta) waves during unconsciousness. This is an unspecific response and can be seen in syncope from various causes, such as venepuncture and distension of the colon and rectum.

A third type has been described, in which syncope is unassociated with any significant alteration in the blood pressure or cardiac rate. This has been called the cerebral type, but its existence is doubtful.

The tumors are ovoid or round in shape, situated at the bifurcation of the common carotid artery and lying partly under the sternomastoid (elevating the anterior border of that muscle) and partly in front of it. The surface is smooth or finely lobulated. The consistency is firm, resembling the texture of a fibrotic tuberculous gland. Lying within the carotid sheath, firmly attached to the artery, they can be moved from side to side but not vertically. On account of their vascularity, they can be temporarily reduced by pressure. Compression of the common carotid artery also temporarily reduces their size. Transmitted pulsation can always be elicited. A few tumors present a bruit and thrill. A sensitive carotid sinus, if present on the same side as the tumor, will give rise to the typical attacks on pressure on the tumor for about 30 seconds. The pharyngeal wall is occasionally displaced by the tumor and physical signs due to pressure on the surrounding nerves are found occasionally.

The correct preoperative diagnosis has only been made in 25 of 180 tumors. The most common erroneous diagnoses are tuberculous glands, branchial cyst, aneurysm, and lateral aberrant thyroid tumor. Secondary malignant glands, branchial carcinoma, neurofibroma, lymphadenoma, and lymphosarcoma must also be considered. A punch biopsy has been suggested, but has been thought dangerous by most workers on account of the vascularity of the carotid body tumor. Even biopsy can be misleading.

The criteria on which to base the diagnosis of carotid body tumors are:

1. A history, extending over several years, of a slow growing painless tumor in the neck.
2. A firm oval tumor in the region of the bifurcation of the common carotid.
3. Free lateral, but very limited or no vertical mobility.
4. Decrease in size on compression of the common carotid artery.
5. Transmitted but no expansile pulsation.

The prognosis depends on whether the common carotid has to be ligated and whether invasion has occurred before operation. The operative mortality is 15 per cent without ligation and 30 per cent when the artery has been tied.

The age of the patient and the duration of the condition are not a guide as to whether malignancy has supervened. More rapid growth and horizontal fixation may be taken as an indication of malig-

nancy. Usually it is only at operation, when difficulty is encountered in shelling out the tumor, that the invasive character is manifest. Nor is age an infallible indication whether hemiplegia may occur after division of the common carotid. The youngest patient with a carotid body tumor in whom ligation of the common carotid resulted in hemiplegia was 26 years old.

Radiotherapy does not appear to have any effect on carotid body tumors. The ideal treatment is total removal of the tumor without carotid ligation.

Hemiplegia may come on immediately after operation when it is due to deficient collateral circulation of the cerebral hemisphere, or it may be delayed for 24 hours or longer, when it may be due to occlusion of the middle cerebral artery by ascending thrombosis. The hemiplegia may be permanent, but often it is only transitory and leaves very little final disability.

An electroencephalogram after compression of the common carotid for from 30 to 60 minutes is the best indication of the competence of the collateral circulation, although it does not exclude the danger of delayed hemiplegia. If the electroencephalographic studies show a deficient collateral circulation and during the course of the operation it becomes obvious that the tumor is inseparable from the vessels, it may be wiser to abandon the operation and to rely on what little help x-rays can give.

In order to lessen the incidence of hemiplegia, manual carotid compression for periods up to 30 minutes for 2 to 3 weeks before operation has been advised. The efficiency of the procedure has not yet been proved. This could be done by a series of electroencephalogram studies. Mechanical devices to close the carotid gradually have been used: a clamp which can be tightened daily, metal bands, and others.

A general anesthetic has been used in most cases as the operation tends to be a long one. The incision should be generous and should run either along the skin creases or along the anterior border of the sternomastoid muscle. The platysma is divided as well and the flaps raised to beyond the borders of the tumor. The deep fascia is incised along the anterior border of the sternomastoid and the muscle retracted posteriorly. The carotid sheath is now opened below the tumor, the common carotid isolated, and a ligature put around it; the ligature is not tied. This is a safeguard in case the artery is torn during the dissection. The internal jugular vein is either stretched across the tumor or pushed backward, and is usually divided. The vagus and sympathetic lie behind the tumor in the carotid sheath and must be carefully preserved. The superior laryngeal nerve of the vagus may be divided if it gets in the way. The hypoglossal nerve should be kept out of harm's way as it runs forward medial to the upper pole of the tumor. The tumor is freed from the surrounding structures on all sides. It can be rotated from side to side to put all adherent structures on the stretch. An attempt should be made to dissect it off the arteries. If the vessels are not completely encircled this should be done by sharp dissection, but if they are completely surrounded it is recommended that an artery forceps be inserted along the vessel from below and dividing the overlying tissues between clamps, much as one would separate the thyroid isthmus from the trachea. It is during this procedure that the vessel is most likely to be torn. If the vessel has to be tied it should be transfixed at the same time. The tumor can now be pulled upward, to expose the vagus in its bed, and dissection proceeds from below upward. The internal and external carotid arteries are then tied and transfixed and the tumor is removed. The skin and platysma are sutured, a small drain being left at the lower end of the wound.

Following ligation of the common carotid the patient should be kept in the Trendelenburg position for 10 days and not allowed up for another 2 to 3 weeks. This minimizes the danger of cerebral anemia, which is the most common postoperative complication, giving rise to hemiplegia, aphasia, facial palsy, and unconsciousness. Deviation of the tongue would follow hypoglossal injury, and vocal cord paralysis would follow damage to the recurrent laryngeal nerve. JOHN E. KARABIN, M.D.

Marshall, Samuel F., and Miles, George O.: Tumors of the Submaxillary and Parotid Gland Areas. *Surg. Clin. N. America*, 1947, 27: 501.

This report is based on a study of 150 tumors of the parotid and submaxillary region. Similar tumors may also arise from the oral cavity, nasopharynx, accessory nasal sinuses, lacrimal gland, and middle ear. When present in these locations the tumors arise from the mucous glands of the area. There were 24 cases of cancer of the salivary gland in this series, 4 of which were of lymphoblastic origin. Parotitis is the most common nonneoplastic swelling confused with parotid neoplasia. A small tumor of only a few weeks' duration should be viewed with suspicion. Parotitis is usually tender to palpation, a most important differential diagnostic point; but if the inflammatory process has become chronic the tenderness may disappear. Angiomas, sebaceous cysts, branchial cleft cysts, and hyperplastic adenitis must also be considered in the differential diagnosis.

In these cases 99 of the patients were females and 51 were males. The average time elapsing before operation was 10.6 years. Frequently with malignant growths a history of rapid enlargement was obtained. Only 2 patients with parotid carcinoma noted paralysis before they discovered a tumor. On physical examination, fixation of the tumor is the most presumptive physical sign of carcinoma. The author does not agree with the statement that small tumors are more likely to recur after operation than large ones. The two major considerations in the operative procedure are to remove a liberal margin of normal salivary gland to avoid recurrence, and to avoid

injury of the facial nerve. To accomplish this the authors isolate and identify the nerve in all cases except those with the most superficially located tumors. Of 13 patients with benign parotid or submaxillary tumors who had no previous surgery, 2 (15%) had a subsequent recurrence. Of 10 with parotid or submaxillary carcinoma, 9 (90%) had a subsequent recurrence. Epidermoid cancer and adenocarcinoma in general give a less favorable prognosis than malignant mixed tumors.

When a decision has to be made during operation between sacrificing the main trunk of the nerve and accomplishing an unsatisfactory excision, the opinion of a pathologist as to the type of tumor may indicate removal of the nerve. Otherwise, the authors make every effort not to enter the tumor bed. There is a great difference in morbidity in cutting the lower and upper divisions of the main nerve trunk. The authors do not hesitate to cut the mandibular branch of the facial nerve for benign disease if necessary, nor do they hesitate to sacrifice any part of the nerve in cases of carcinoma if the nerve definitely traverses the tumor.

The authors strongly recommend isolation of the main trunk of the nerve in all but the most superficial benign parotid tumors. They isolate the nerve as it exits from the stylomastoid foramen, and by careful dissection follow it forward. Before the actual isolation of the nerve is accomplished the external maxillary artery is identified and ligated, which markedly reduces bleeding in the operative area. The nerve itself leaves the stylomastoid foramen 1 or 2 cm. medial to the lateral surface of the mastoid process and 1 cm. superior to its tip.

F. J. Lesemann, Jr., M.D.

Ruzicka, Edwin R., and Eversole, Urban H.: The Management of Anesthesia for Surgery of the Neck. *Surg. Clin. N. America*, 1947, 27: 517.

Of fundamental importance in the administration of anesthesia, particularly in cases of neck surgery, is the maintenance of a clear airway. Endotracheal tubes are often indicated. The author advises against the routine use of blind intubation by the nasotracheal route. Profuse nasal hemorrhage may be a serious complication. Fluids should be administered through a leg vein.

General anesthesia is recommended in all cases of thyroid surgery. Cyclopropane has the serious disadvantage of increasing the irritability of the heart muscle and should probably not be used on thyrotoxic patients. The endotracheal tube should be used when there is deviation or compression of the trachea, cancer of the thyroid, intrathoracic extension of the tumor, paralysis of either or both vocal cords, and for all secondary operations. If there is marked encroachment on the airways by the thyroid tumor or if preoperative stridor is present, the endotracheal tube should be placed in position under topical anesthesia before a general anesthetic is administered.

When surgery is being performed for esophageal diverticulum, no oral preoperative medication should be given because of the possibility that the medication may enter the diverticulum and thus exert no effect. An endotracheal tube with an inflatable cuff should always be employed to prevent aspiration. Laryngoscopy, bronchoscopy, and esophagoscopy may be performed under sodium pentothal and curare anesthesia.

Laryngectomy presents a problem in the maintenance of an airway. If a tracheotomy has been previously established, the tracheotomy tube can be removed under pentothal anesthesia and a metal endotracheal tube with an inflatable rubber cuff may then be placed in the trachea. An excellent airway is thereby maintained. If a tracheotomy has not been done previously, the orotracheal tube is used in the usual manner until the larynx is excised, and the tube is then inserted into the tracheotomy opening. Patients with bilateral vocal cord paralysis often need emergency endotracheal intubation, and this can best be done under topical anesthesia.

F. J. Lesemann, Jr., M.D.

Brunschwig, Alexander; and Camp, Edward: One-Stage Resection of Total Cervical Esophagus, Larynx, Base of Tongue, Hypopharynx, Cervical Trachea, and Bilateral Cervical Lymph Node Chains for Carcinoma Primary in the Cervical Esophagus; Reconstruction of the Cervical Esophagus. *Laryngoscope*, 1947, 57: 305.

The authors relate the case history of a woman 33 years of age who had a squamous cell carcinoma arising on the anterior wall of the cervical esophagus immediately adjacent to the larynx. To insure adequate removal of the tumor it was necessary to remove the larynx, cervical trachea, base of the tongue, the hypopharynx, and the cervical esophagus, together with the cervical chain of lymph nodes on each side.

Reconstruction of the esophagus was begun at the initial operation by creating half a cutaneous tube or gutter from the oropharynx to the transected esophagus by use of a skin flap from the neck. At a second operation 10 weeks later the other half of the cutaneous tube was fashioned by raising a skin flap again from the side of the neck. Dermatome grafts and pinch grafts were used to epithelize the raw surfaces.

Diagrams and photographs are used to illustrate the technique and result.

The authors believe that the case illustrates the feasibility of radical surgical attack upon cervical esophageal cancer. Edward H. Camp, M.D.

SURGERY OF THE NERVOUS SYSTEM

BRAIN AND ITS COVERINGS; CRANIAL NERVES

Davis, Loyal; and Perret, George: Cerebral Thromboangiitis Obliterans. *Brit. J. Surg.*, 1947, 34: 307.

Eleven cases of cerebral thromboangiitis obliterans are presented with signs and symptoms similar to those produced by a slowly growing intracranial tumor. Only 3 of the patients had evidence of peripheral circulatory disturbances. In 9 of the 11 cases with a similar clinical picture an osteoplastic craniotomy was performed. The gross and microscopic changes in the cerebral vessels are described and the changes are illustrated in several photographs made at the time of operation. The anatomical diagnosis is made by the presence of the characteristic small, white, wormlike obliterated vessels, the granular atrophy of the cortex, and the presence of thrombi associated with proliferation of the endothelial cells of the intimal and subintimal layers of the vessels.

The clinical diagnosis is more difficult. Cerebral thromboangiitis obliterans occurs most commonly in people between the ages of 30 and 50. Most symptoms are transient in the beginning, come in attacks, and recede completely. The history is usually of long duration and is characterized by unilateral sensory disturbances followed by weakness and transitory paralysis. Speech disturbances and visual field defects were also common.

Air studies were performed in 6 cases and the predominant findings were cerebral atrophy with enlargement of the ventricular system and subarachnoid spaces. Arteriography was not performed in any of the cases.

An excellent bibliography and review of the literature is given. The purely cerebral form was first described by Foerster and Guttmann in 1933. It is frequently diagnosed as lues, juvenile arteriosclerosis, hypertension, atypical multiple sclerosis, or an intracranial tumor. The condition is not as rare as might be expected and may very well be responsible for many organic cerebral changes which are not clearly diagnosed and which masquerade under the name of other diseases. HOWARD H. LANDER, M.D.

McNickle, H. F.: The Surgical Treatment of Hydrocephalus. *Brit. J. Surg.*, 1947, 34: 302.

The author describes a method of performing third ventriculostomy for the surgical relief of hydrocephalus. Briefly, the method is to puncture the floor of the third ventricle by means of a hollow needle passed from above into a lateral ventricle, directed through the foramen of Monro into the third ventricle by touch or by telescope, and advanced to its destination under the x-ray screen.

Four cases of noncommunicating hydrocephalus and 3 cases of communicating hydrocephalus were treated and the results presented. The author believes that the division of hydrocephalus into communicating and noncommunicating types is an arbitrary one and has been overemphasized. He also states that cauterization of the choroid plexus seems to be wrong in principle. Floating debris after the operation must sometimes aggravate the hydrocephalus.

Included also is a discussion of the cause of hydrocephalus. The rationale of third ventriculostomy is given, and suggestions are made for the prevention and treatment of the type of hydrocephalus associated with lumbar myelomeningocele.

HOWARD H. LANDER, M.D.

SPINAL CORD AND ITS COVERINGS

Barr, Joseph S.: Ruptured Intervertebral Disc and Sciatic Pain. *J. Bone Surg.*, 1947, 29: 429.

In 1934, Mixter and Barr drew attention to the syndrome of the protruding intervertebral disc and since that time the subject has been of considerable interest to neurosurgeons and orthopedic surgeons throughout the world. It is fitting, therefore, that one of the co-authors of that original paper should now summarize his views on the subject of the development of the syndrome and the various aspects of it which are of interest to all those who have to deal with this condition.

In the present article the author reviews the end-results obtained in patients treated for ruptured disc in the years 1939 to 1943, inclusive. The study comprises 234 cases—102 with spinal fusion and 132 without spinal fusion. Some of the patients were sent a questionnaire to be filled out; others reported for re-examination and re-evaluation. The questionnaire goes into sufficient detail to bring out the points that are of interest in the end-result. Of particular interest is the comparison of improvement in patients with, and in patients without spinal fusion. The tables are set up in such a way as to show the differences between these two types of treatment by placing the statistical studies side by side. The results of the questionnaire show a slight but definite superiority of the result obtained with fusion over the result obtained without fusion when all types of complaints and disabilities are considered. There was one death from massive pulmonary embolism 27 days following the operation of spinal fusion.

In a series of 24 compensation cases, 60 per cent of the patients had absolutely no complaint and 71 per cent were back at full duty. It is pointed out that some of the poor results in compensation cases are due to improper treatment and neglect, mental and physical deterioration, poor operative technique, and unnecessary weakening of the architecture of the spine; also, there are conditions still diagnosed as ruptured disc in spite of negative exploration. Many compensation cases are those of laborers whose work

involves considerable back strain. It is pointed out that one cannot expect to return these patients to work for at least 6 months.

The author reports his experiences at the United States Naval Hospital, Bethesda, Maryland. Prior to his arrival the neurosurgeons were removing discs without spinal fusion, but they were glad to co-operate with him in performing fusion in a great many, if not most, of the cases observed after his arrival at that institution. The enlisted personnel, however, following the operation of removal of discs and spinal fusions, were not considered suitable for full duty as this involved twisting and lifting.

The technique of fusion employed by the author is that previously described by Bosworth, and consists essentially of a clothes-pin graft taken from the ilium. Myelography was used routinely in these cases with removal of the pantopaque. A conservative preliminary attitude is recommended for at least a period of 6 weeks as an operation of this magnitude is not considered to be without risk. The author believes that the best trend of treatment is towards removal of the disc and fusion of the spine. Views are expressed on related details associated with the diagnosis and treatment of the ruptured intervertebral disc with sciatic pain. ADRIEN VER BRUGGHEN, M.D.

Lenhard, Raymond E.: End Result Study of the Intervertebral Disc. *J. Bone Surg.*, 1947, 29: 425.

The author presents a condensed, four page statistical study of the end-results obtained by Walter Dandy in the treatment of the intervertebral disc. Eight hundred and forty-three patients were operated upon during the period from 1941 to 1944 inclusive, and in March, 1945 questionnaires were sent out. Five hundred and thirteen, or 60 per cent of the patients, returned the questionnaire, and 147 patients returned for examination. These formed the basis of the study.

There were three phases of development of the treatment carried out in these cases. Before January, 1942 the loose fragments were removed. During the period between January, 1942 and January, 1943 a curettage, or removal of the entire disc was carried out. After June, 1943 multiple discs were recognized and removed completely. The third procedure produced the best results.

Examination of the 147 patients revealed good results in 67.5 per cent of the patients, improvement in 17 per cent, and no improvement in 15.5 per cent of the patients. Of the 513 patients replying to the questionnaire (not examined), good results were obtained in 59.5 per cent, improvement in 22.9 per cent, and no improvement in 17.6 per cent. A few of the patients were entirely relieved of symptoms and were able to perform their normal duties without complaint. In none of these patients was fusion accomplished according to any orthopedic standard. Among the 147 patients who returned for examination, 20 had had multiple operations, 16 had had 2 operations, 2 had had 3 operations and 2 patients had had 4 operations.

Pantopaque studies were not used routinely as, in 90 per cent of the patients the lesion was said to have occurred at the fourth and fifth lumbar vertebra. There was no distinct relationship between the narrowed space and the faulty disc. The author points out that prior to 1941 Dandy doubted the frequency of occurrence of ruptured disc, but after he had seen many cases he became convinced that all low back pain, with or without sciatic pain, was caused by injury or abnormality of the intervertebral discs.

ADRIEN VER BRUGGHEN, M.D.

Livingstone, R. G., and Leach, J. E.: Intrathecal Penicillin in Bacterial Meningitis. *Surgery*, 1947, 21: 683.

The variable reports regarding the efficacy of penicillin by various routes of administration warrants any additional information that will be of benefit. The present report, from the Memorial Hospital, New York, concerns 2 patients with meningitis, in whom the intrathecal administration of large doses of penicillin was believed to be of unequivocal benefit.

In both cases the meningitis was due to direct invasion of the subarachnoid spaces following operative procedure about the nasal cavity and ethmoid and sphenoid sinuses, respectively. At the onset, therapy consisted of treatment with penicillin intramuscularly, and with sulfonamides orally, in the doses usually recommended.

In the first case the infection (streptococcus viridans) was not controlled over a period of 27 days despite the administration of 8,640,000 units of penicillin. At that time 100,000 units of sodium penicillin dissolved in 5 c.c. of spinal fluid were injected intrathecally, daily. On the fourth day the patient had two generalized convulsive seizures; on the fifth day she was found to be disoriented and drowsy. Only 10,000 units were given intrathecally for another 2 days and all medication was then discontinued, since the laboratory tests and temperature indicated that the patient had recovered. Although the authors believe that the convulsions and mental aberrative episodes were not due to penicillin, this point is easily doubted. However, the undoubted control of the infection is of the greatest importance.

In the second case, the patient was treated with 50,000 units of sodium penicillin in 5 c.c. of spinal fluid injected very slowly, intrathecally. This was started at the beginning of the meningitis although the patient had been receiving penicillin and the sulfonamides prophylactically for 3 days. Cultures revealed a pure growth of Streptococcus hemolyticus (group A). Subsequent studies revealed the organism to be relatively resistant to penicillin. No untoward neuroirritative signs were noted.

Despite the known potential dangers of penicillin intrathecally, the use of large doses of penicillin in the absence of lumbar block is recommended in fulminating and resistant cases of meningitis.

JACK I. WOOLF, M D.

SYMPATHETIC NERVES

Guttmann, L., Riches, E. W., Whitteridge, D., Jonason, P. H. A., and Others: Discussion on the Treatment and Prognosis of Traumatic Paraplegia. *Proc. R. Soc. M.*, Lond., 1947, 40: 219.

GUTTMANN: The studies in this article were made upon 177 casualties who were patients in the Spinal Injuries Center, Ministry of Pensions Hospital, Stoke Mandeville, since February, 1944. Of this group, 108 patients had suffered gunshot injuries while 69 had fractures of the spine. Emphasis was placed on the care of the bladder with the use of the intermittent or constant, indwelling catheter and modified tidal drainage. Suprapubic cystotomy was deemed preferable for cases with narrow urethras, urethral strictures, or presenting other local urethral injuries. The development of the automatic reflex activity of the bladder and voluntary micturition by pressure was encouraged. Prevention of stone formation was accomplished by shortening the interval of recumbency and by restoring the best possible fitness of the patient. Stress was placed on the importance of recognition of autonomic phenomena above the site of a complete cervical or thoracic cord lesion caused by abnormal distention of a viscus without pain below the site of the lesion. Prevention of contractures and atrophy were carried out by adequate physiotherapy. Control of spasms was accomplished in selected cases by the intramedullary injection of 1 to 2 c.c. of 80 per cent alcohol into the thoracolumbar junction. For generalized rehabilitation of paraplegics a center has been set up near Macclesfield to provide aid in social and industrial readjustment.

RICHES: In care of the bladder, drainage is essential, but it need not be immediate if strictly aseptic methods for catheterization are not available. A high suprapubic cystotomy with tidal drainage affords the best type of care. With an indwelling catheter, urethritis is always present and extension of ascending infection is by direct lymphatic spread through the periurethral lymphatics to the kidney. There is no such communication between the suprapubic catheter and the kidneys, and ascending infection is less common from a bladder which is draining freely. As soon as an automatic bladder becomes established on tidal drainage the small, high suprapubic cystotomy wound closes rapidly and spontaneously, whereas closure of a low lying cystotomy is prolonged and requires excision. Infection, recumbency, and dilatation of the upper urinary tract are important factors in the production of renal calculi. Since these do not disappear on ambulation, their removal must be surgical. Vesical calculi can occasionally be dissolved by the use of the Albright-Suby solution in the suprapubic tidal drain.

WHITTERIDGE: With distention of the bladder in patients having a complete cervical or high thoracic (above T_8) spinal cord lesion there is a tendency toward marked vasoconstriction with a rise in the blood pressure, a sharp drop in the pulse rate, a great increase in volume of the pulse, and a rise in the temperature of the ear. With a lesion at or below T_6 there is a slight rise in the blood pressure, a drop in the pulse rate and volume, and a decrease in the temperature of the legs. In the latter group of cases vasomotor regulation is possible because there still is a large vascular bed which can be used by the vasomotor center for compensatory dilatation. With lesions above T_5 the area controlled by the vasomotor center is greatly reduced. There is no doubt that this phenomenon is dùe to a spinal reflex.

JONASON: Rehabilitation is less difficult in paraplegics with more distal cord lesions than in paraplegics with complete cervical or high thoracic cord transections because of the fewer vasomotor disturbances in the former group. In the higher level type of case, the patient exhibits much more profound and lasting effects upon assuming an upright position than in the low level type. This is due to a cerebral anemia which is secondary to the drop in blood pressure associated with the higher cord lesions.

RUSSELL: Neither the neurologist nor the orthopedic surgeon alone can adequately deal with the care and rehabilitation of paraplegics, and the argument for their segregation into special centers is indisputable. RICHARD C. SCHNEIDER, M.D.

Leger, L., and Coste M.: Recurrent Syncope Associated with Sinus Hyperactivity. Cure by Denervation of the Carotid Sinus. (Syncopes à répétition liées à une hyperréflectivité sinusal. Guérison par énervation sinu-carotidienne.) *Presse méd.*, 1947, 55: 174.

A 62 year old male presented himself stating that for the past 15 months he had been experiencing episodes varying from simple syncope with slight dyspnea and bradycardia, to severe periods of unconsciousness, occasionally with convulsions. When unconscious, there was often complete cessation of the pulse and respiration. He never experienced incontinence or tongue biting and was able to tell when these episodes were approaching. The attacks were precipitated by any effort, such as sitting, changing position, defecating, urinating. Because of this illness the patient was forced to follow an extremely rigid way of life by discontinuing all activity and residing at home. Even these severe restrictions did not completely stop all the episodes or their equivalents.

Empirically, warm compresses on the neck were found to be of greatest value, more so than various stimulating drugs. Numerous clinical and laboratory examinations, with particular attention to the cardiac status, showed no abnormalities. The blood pressure was 130/80. Many medical treatments were attempted, but none proved successful: iodides, adrenalin, atropine, digitalis, strophanthin, acetylcholine, theophylline, vitamin B, and various diets. The diagnosis was verified by the following maneuver:

The patient attempted to sit up. This caused marked syncope with loss of consciousness and cessa-

tion of the pulse and respiration which resumed slowly after several minutes. Pressure over the left carotid sinus caused the unconsciousness to reappear and the pulse rate to slow. Pressure on the right, to the contrary, produced no effect. During one of these episodes the left carotid sinus was injected with novocaine with immediate return of consciousness.

Treatment was instituted by infiltrating the left carotid sinus with novocaine and denervating it. Atropine was given before the operation. Following this procedure, the patient no longer presented any of the former reactions and at the time of writing had had no recurrences.

This syndrome was first described by Tschermak in 1886, who noted that pressure on the right lateral aspect of the neck in a patient caused a sensation of weakness, vertigo, and slowing of the pulse. To date, more than 100 clinical cases have been published. The crisis is characterized by vertigo, sweating, loss of consciousness, pallor, apnea, cessation of pulse, hypotension, occasionally convulsions, and rarely incontinence. One death has been reported, due to compression of the carotid sinus. Transitory and permanent hemiplegias have occurred. The syndrome has been noted in many various forms, and minor equivalents have been described as simple syncope, vertigo, malaise, and mild anxiety.

The syndrome is precipitated by traumatism, often only slight. It can be produced by the constriction of a tight collar, by shaving, and, less frequently, by simple cervical hyperextension, or the hyperextension when lying in a lateral supine position. Certain instances have appeared with carotid tumors; their excision abolished the symptoms. Often, no precipitating reason can be found and it is hypothecated that the sinus is stimulated by a sudden rise in the blood pressure in response to exertion or some hormonal secretion. The definitive diagnosis is established by production of the syndrome by compression of the carotid sinus, and of its abolition by infiltration of this region.

A definite etiology of carotid sinus hyperactivity cannot be given at present, although arteriosclerosis has been suggested. The carotid sinus is often affected by arteriosclerosis and this pathological change may disturb its normal functioning.

According to Ferris, Capps, Weiss, and Munro, whose observations were based on 52 cases, 3 different types of hyperactivity have been distinguished:

1. The vagal type seen in one-third of the cases. The symptoms are related to a sinoauricular or an auriculoventricular heart block which causes a cerebral anemia. Adrenalin or atropine prevents the attack. This syndrome is relieved by medical treatment.

2. The depressor type, rarely found. Stimulation of the carotid sinus causes a generalized venous dilatation with a secondary hypotension. These symptoms respond to adrenalin, but are not influenced by atropine. Other stimulants such as ephedrine and benzedrine are helpful. Denervation of the sinus is indicated in this type.

3. The cerebral type, observed in two-thirds of the cases. Sinus stimulation appears to cause hypothalamic activity. Atropine and adrenalin have no effect. This syndrome is not helped by medical treatment and should be treated exclusively by surgery (denervation of the sinus).

Operation should be done under local anesthesia only after preoperative administration of atropine and novocaine infiltration of the carotid sinus. This is to prevent the carotid sinus syndrome from recurring during operation. It is rarely that the denervation needs to be done bilaterally. In the 28 cases collected from the literature, surgery was done unilaterally in 25 instances with definitive cure in 65 per cent. C. FREDERICK KITTLE, M.D.

MISCELLANEOUS

Poppen, J. L., and Lemmon, C.: The Surgical Treatment of Hypertension. *J. Am. M. Ass.*, 1947, 134: 1.

The authors report a consecutive series of 100 cases of hypertension treated by an extensive thoracodorsal sympathectomy from the third or fourth thoracic through the second lumbar ganglia. This was done to attain more permanent and immediate lowering of the blood pressure than they had apparently achieved by the Smithwick operation.

The operative procedure was carried out through a curvilinear incision from the sixth rib to the border of the twelfth rib. A 4 cm. portion of the eighth and eleventh ribs was resected and the chain was resected without incision of the diaphragm. The operation was performed under high spinal anesthesia supplemented with sodium pentothal.

The most important problem in regard to sympathectomy lies in the proper selection of the patients. Although definite criteria are lacking, a correlation of the various tests and the clinical impression will help to rule out many patients that would not be benefited. The contraindications are as follows: cardiac failure, renal failure, and severe retinal arteriosclerosis with a fixed blood pressure. Patients with early and mild hypertension were not operated upon. Considerable caution was exercised in the selection of patients with a previous coronary thrombosis, angina pectoris, auricular fibrillation, or gallop rhythm. Cerebrovascular episodes, in an otherwise suitable candidate, were not considered a contraindication to surgery. The most suitable candidates were those under 50 years of age with definite progression of the hypertension, ocular fundi of grades 2, 3, or 4 (Keith, Wagener, and Barker), and in whom the examination did not reveal any of the contraindications already mentioned.

The interpretation and evaluation of results were modified slightly in that a normal blood pressure in an otherwise incapacitated patient was not considered a good result, but a blood pressure slightly

above the accepted level of 150 mm. systolic and 100 mm. diastolic in a patient in excellent health was considered a good result. Although the authors realize the inadequacy of using the blood pressure level as a criteria, there is no other scientific measuring rod at present. The results are quoted as follows: good, 47 per cent; fair, 24 per cent; and unsatisfactory, 22 per cent. Six patients died after dismissal from the hospital but there was only a 1 per cent surgical mortality. A rather surprising finding was that the known duration of the hypertension did not influence the results of the sympathectomy. Although the greater number of patients had their hypertension less than 5 years, the results were not appreciably better in these than they were in the patients with hypertension of longer duration.

An apparently worthwhile innovation is the practice to perform a unilateral sympathectomy when a nephrectomy is performed in the presence of hypertension. If the blood pressure drops to normal, the patient is dismissed for follow up; however, if no improvement ensues, the second stage sympathectomy is then performed. JACK I. WOOLF, M.D.

Palmer, R. S.: The Surgical Treatment of Hypertension. *J. Am. M. Ass.*, 1947, 134: 9.

The author reports his evaluation of sympathectomy for hypertension from the standpoint of a medical observer. The effect upon the blood pressure was considered as the most important criterion. The upper limits of the normal blood pressure were considered as 150 mm. Hg. systolic and 110 mm. Hg. diastolic. After 5 years, only 12 per cent of 74 patients treated by supradiaphragmatic sympathectomy had a normal or near normal blood pressure, the favorable results occurring largely in hypertension of grades 1 and 2. The results were much improved after Smithwick extended the resection of the sympathetic chain from above the ninth dorsal ganglion to below the second lumbar ganglion.

A 1 year followup of 49 patients who underwent the thoracodorsal sympathectomy revealed that 53 per cent had a normal blood pressure. The patients with hypertension of grades 1, 2, and 4 obtained the better results.

After 3 years a follow-up study of 68 sympathectomized patients gave the following results: 30 per cent were dead; 45 per cent had failed to obtain a satisfactory blood pressure response, and 25 per cent had maintained normal or near normal blood pressures. The patients that may have obtained a partial drop in blood pressure with subjective improvement were not listed. In comparing these figures with a medical series, it was found that 30 per cent of the latter had expired. A group of 100 patients maintained on a general medical regimen plus potassium thiocyanate revealed that under the best conditions of medical treatment a sustained normal blood pressure could be effected in only 12 per cent of the patients.

A study of the surgical group failed to reveal a definite guide as to the selection of patients. However, the following facts were noted: (1) in a greater proportion of the successes the blood pressure would approach the normal levels spontaneously; (2) high maximum levels of diastolic pressure were more frequent in the unsuccessful cases; (3) the sedative test resulted in a drop to normal in 7 of 14 successful cases and in 4 of 13 unsuccessful cases; and (4) the pulse pressure groupings had no significance. In general, it is stated that women and younger patients with less evidence of organic changes have better chances of obtaining good results.

Although 75 per cent of the definite successes occurred in cases of hypertension of grades 1 and 2, the most important observation pertained to the 11 cases in the malignant hypertensive group. Three patients who obtained normal pressures are alive and working, 1 for 3 years and 2 for about 5 years. Two failed to obtain a drop in blood pressure but are active and working, 1 for 3 years and the other for 5 years. These are certainly outliving their life expectancy. The remaining 6 patients have died but all had either renal or cardiac damage, or both. It would be of interest to know whether any of these had obtained a satisfactory blood pressure response to surgery.

An important phase of sympathectomy pertains to the various physiologic effects, disabilities, and dangers. A 2 per cent mortality rate was found in this series and it compared favorably with other groups. Complications of surgery are the development of extrapleural fluid, pneumothorax, and basal atelectasis; however, these are usually overcome easily. Postoperative neuritis is frequent and may last from a few weeks to several months. Postural hypotension with compensatory phenomena, such as tachycardia and breathlessness, may persist for several months and to a lesser degree for longer periods of time.

Despite the fact that only a fourth of the patients were deemed to have received the maximum benefit of a maintained normal blood pressure, "perhaps 60 per cent" showed a persistent improvement in the general level of their blood pressure.

JACK I. WOOLF, M.D.

SURGERY OF THE THORAX

CHEST WALL AND BREAST

Hopkins, F. S., and Egnatz, N.: Carcinoma of the Breast. *N. England J. M.*, 1947, 236: 530.

The routine procedure at the time of the first visit of a patient with suspected cancer of the breast consisted in taking x-ray films of the chest, as well as of the upper ends of the humeri, the skull, the spine, and the pelvis, including the upper ends of the femurs. Unsuspected metastases have been found in several cases that would otherwise have been deemed operable. Other contraindications that have been found are fixed matted lymph nodes in the axilla and definite inflammatory carcinoma. If there was any suspicion of involvement of the supraclavicular nodes, a biopsy was first done.

The patient's general condition was not considered as a contraindication to operation, although most of the simple mastectomies were done because of poor physical condition. There were deaths in 3 cases after radical operations, and 1 death following a simple mastectomy—all in patients over 75 years of age and in poor physical condition. Since then, cases in the older age group were carefully evaluated and only referred for radiation therapy if there was a life expectancy of at least 5 years. After this procedure had been adopted, there were no postoperative deaths.

Most operations began with a local excision of the tumor and a frozen section to confirm the diagnosis. A formalin-soaked sponge was placed in the cavity before suture was done, and the wound was sealed with collodion and gauze. The usual incision was of the Rodman-Greenough type. The important feature is to make the incision include an area of skin at least as wide as the breast and with the tumor at least 5 cm. from the incision. After the pectoral muscles have been divided at their insertion, a meticulous dissection of the axilla is made, all areolar tissue being removed from the axillary vein. The upper rectus fascia is removed with the breast, muscles, and axillary contents. Wide undercutting usually permits closure without grafting. The cure rate for radical mastectomies was in direct proportion to the duration of the operation. The procedures lasting less than an hour amounted to 28.6 per cent, whereas for each successive hour of operating time, they amounted to 35.3, 34.3, 43.7, and 56.3 per cent, respectively.

Preoperative x-ray treatment was not used, but all patients with axillary metastases were given postoperative radiation. Women who were still menstruating were offered ovarian radiation.

In the determination of the results the operative deaths and patients alive with recurrences were classed as failures. Of the 70 patients who had radical operations, 30, or 43 per cent, are living and well, without evidence of cancer. Of the 45 cases with axillary metastases 1.4, or 31 per cent, are considered 5 year cures. Sixteen of 25 patients, or 64 per cent, with no involvement of the axillary lymph nodes, are living and well. It is the authors' opinion that complete radical operation should be done at the time of the first surgical approach to a cancer of the breast.

The following are considered definite contraindications to operation: distant metastases, inflammatory carcinoma, supraclavicular metastases, edema of the arm, intercostal or parasternal nodules, satellite nodules in the skin over the breast, extensive edema of the skin, and carcinoma developing during pregnancy and lactation. Other factors of such poor prognostic significance that the presence of any two is regarded as a contraindication to operation include: ulceration of the skin, limited edema of the skin (less than a third), fixation of the tumor to the chest wall, axillary lymph nodes measuring 2.5 cm. or more in the transverse diameter, fixation of the axillary lymph nodes to the skin or the deep structures of the axilla, and metastases in the nodes proved by biopsy.

The percentage of lymph node involvement and the microscopical grade of the tumor are of aid in making a prognosis. X-ray treatment is of great help in making the patient more comfortable.

LEE PULLEN, M.D.

TRACHEA, LUNGS, AND PLEURA

Adams, R., and Ficarra, B. J.: Bronchiectasis. *J. Am. M. Ass.*, 1947, 134: 240.

This is a report of 50 consecutive, surgically treated cases of bronchiectasis at the Lahey Clinic in the 5 year period ending August 31, 1945. There were no deaths in the series, which showed that bronchiectasis may be cured and functional usefulness restored by appropriate pulmonary resection.

Bronchiectasis is an important pathological entity from a socioeconomic viewpoint. A chronic illness will alter the personality and influence the character and career of an individual. Persons with this disease are branded as having tuberculosis. Children's schooling is neglected because their illness renders them unable to keep pace with their classmates. When the teens are reached antisocial patterns are more clearly defined, and in the 20's and early 30's increasing responsibilities of life and decreasing recuperative powers lead to frequent "break-downs."

No one etiological agent can be found for bronchiectasis. Among the common contributing causes are: (1) diseases of the accessory air passages; (2) acute infections of the upper respiratory tract or infectious diseases; (3) congenital malformations, such as cystic disease of the lung; (4) bronchial obstruction due to a foreign body, hyperplasia of the

mediastinal nodes, or tumor; (5) emphysema or atelectasis; and (6) situs inversus and sinusitis. From these it can be seen that the basic mechanisms in the development of bronchiectasis are infection of the bronchial wall and bronchial obstruction.

In some cases following pneumonia, x-ray evidence of bronchiectasis appears and disappears in 1 or 2 months as silently as it developed. This is called "pseudobronchiectasis" or "transitory bronchiectasis."

Initially, infection causes hyperemia and thickening of the mucosa. Eventually, highly vascular papillary projections of the mucosa protrude into the lumen. From dilatation peripheral to an obstruction, cylindrical bronchial enlargement or cavitation is produced. Later, the lung parenchyma is replaced by fibrous tissue. When the cavities become infected, purulent material accumulates. If putrefactive organisms invade secondarily, the sputum odor is foul. Occasional pulmonary abscesses form.

Histologically, one sees inflammation, proliferation, and tissue destruction. The bronchial wall is infiltrated with leucocytes and lymphocytes. If the disease is chronic, the glands, elastic tissue, muscle fibers, and even cartilage may be replaced by fibrous tissue. The epithelial continuity may be broken but it is the last to be destroyed. Blood vessels in the wall may rupture or become thrombosed (if infected, a metastatic brain abscess may result). The adjacent pulmonary tissue becomes infected and, later, fibrotic. There are peripheral zones of compensatory emphysema.

In congenital bronchiectasis the lung contains many cystlike cavitations lined by a layer of flattened or cuboidal epithelium, often ciliated. This pathologic entity may be called congenital cystic disease of the lung.

Bronchiectasis may involve one or more bronchopulmonary segments within a lobe or it may be multilobar. The basal division of the lower lobes is most frequently involved, as opposed to lung abscess which usually occupies the dorsal division of the lower lobe. The anatomic pattern is static, and the disease does not spread from lobe to lobe. This justifies the rationale of resection of the involved bronchopulmonary segment. Most of the unsatisfactory results are due to failure to appreciate the high incidence of residual disease in an unresected lingula.

Clinically, one may see a chronic uncontrollable productive cough, foul breath, hemoptysis, purulent sputum, chest pain, and dyspnea on exertion. Symptoms are usually more evident in the morning.

Physical signs vary with the extent of secondary infection and atelectasis. Dullness, diminished breath sounds, and moist rales are positive findings over the involved segments. Clubbed fingers are common in long standing disease.

The x-ray findings of collapse, dilated bronchi, and compensatory expansion of the adjacent pulmonary tissue are characteristic. Fluoroscopy and lateral views are desirable. Bronchography is rarely necessary for diagnosis but is necessary for determining the extent of the process prior to surgical attack.

Patients under 50 with unilateral disease limited to one collapsed lobe, with infection temporarily quiescent, and who otherwise are in good physical condition constitute the best candidates for surgical treatment. Patients with diminished respiratory reserve, bilateral disease, advanced emphysema and fibrosis, chronic asthma, and chronic pulmonary suppuration are greater surgical risks.

Operation should be carried out only when the patient is in the best physical condition. He is given a nutritious diet supplemented by vitamins and iron, daily periods of rest and graded exercise, and postural drainage supplemented by bronchoscopic aspirations when necessary. Associated pleural infections are drained dependently until active infection is minimized. Sinus disease is eradicated. Sulfonamide or penicillin (by muscular injection or inhalation) is given preoperatively to reduce infection.

The operative technique stresses gentle careful dissection to complete incomplete fissures. The hilar vessels are individually exposed and tied. The bronchus should be closed in meticulous fashion with 2 rows of fine interrupted silk stitches, the posterior membranous portion being folded into the anterior cartilaginous portion and the stump being buttressed with a free fascial graft or a pedicled flap of parietal pleura. The tourniquet technique is no longer used.

After operation, measures are employed to prevent shock, anoxemia, or failure of complete lung expansion. Fluid formation in the pleural space should be prevented or removed and obstruction of the bronchial tree must be prevented. Blood transfusions and oxygen therapy are routine. Opiates are used sparingly and voluntary coughing to clear secretions is encouraged. Negative intrathoracic pressure is maintained by a drainage catheter which is usually removed in 3 days. Bronchoscopic aspiration is used when indicated. Prophylactic use of penicillin is continued for about 1 week. Infection and empyema are the common complications. Effective stump closure, the use of sulfonamides or penicillin, and the complete re-expansion of the remaining lobe or lobes aid in eradicating postoperative infection.

Forty-five of the patients contracted the disease before the fifth decade. In 50 per cent the duration of symptoms was from 1 to 5 years, in 30 per cent from 5 to 10 years, and in 20 per cent from 10 to 20 years. Associated infections of the accessory nasal sinuses or of the respiratory system were present in nearly all of the patients. There were 31 women and 19 males in this series.

All 50 patients were treated by pulmonary resection. In 19 cases the disease was on the right side, in 31 on the left, and in 5 bilateral involvement was present. One pneumonectomy was done; bilobectomies were done in 18 cases. The lingula was affected in 43.3 per cent of the cases.

All of the patients received intratracheal anesthesia with cyclopropane-ether. There were 5 postoperative empyemas requiring drainage, 2 persistent

bronchopleural fistulas, and 1 thrombophlebitic complication. In this series followups from 1 month to 5 years were carried out, and all but 2 patients with contralateral disease are in good health. There were no deaths.

The prognosis following pulmonary resection is favorable. Almost all of the patients were cured or significantly benefited. Forty-two of the 50 have been able to resume normal activity. From this study it can be concluded that beneficial surgical results indicate the inefficiency of medical treatment. True cure can be obtained only by resection of the diseased lung tissue. Other treatment only results in symptomatic relief. Surgery should be advised early in the disease. ROBERT R. BIGELOW, M.D.

Ochsner, Alton; DeBakey, Michael; and Dixon, Leonard: Primary Pulmonary Malignancy Treated by Resection. *Ann. Surg.*, 1947, 125: 522.

Ochsner and his associates present a very completely detailed analysis of 360 cases of carcinoma of the lung observed during the 11 year period from 1936 to 1946, inclusive.

Twenty-seven charts add greatly to the lucidity of the presentation. Of the total 360 cases, 129 were resected. Among these were 124 cases of bronchogenic carcinoma, 2 of fibrosarcoma, and 1 case each of melanosarcoma, neurogenic sarcoma, and lymphoblastoma.

Lung carcinoma was encountered over twice as frequently among white as among colored persons.

Eighty-six per cent of the lung carcinomas were in males. (In 6,769 collected cases, 79 per cent were in males; adenomas, however, are slightly more frequent in females.) Primary cancer of the lung is exceeded only by primary cancer of the stomach in males.

The great majority of cases (over 87%) occurred in patients between the ages of 40 and 70 years. Among the 129 resected cases, no significant etiologic factor was found. Neither occupation nor smoking seemed to be of etiologic significance.

The clinical picture is not sharply characteristic and the onset is insidious. The most common symptoms were, as others have found, cough, weight loss, discomfort in the chest, and hemoptysis, in that order. In many of the early cases, only one or two of these symptoms were present. Early physical findings are likely to be negative. Seventy-six cases were found in the right lung and 53 in the left. The upper lobes on each side and the right lower lobe were involved in practically the same incidence.

Positive roentgen diagnosis was made in 81 per cent of the cases. Bronchoscopy was done in 112 cases. In 17 of the 129 cases, x-rays showed the tumor to be so peripheral that bronchoscopy was not done. Biopsy was obtained in 61 per cent. Eighty-one per cent of these cases were positive. Aspiration biopsy is condemned because of the danger of pleural implantation; the authors had 2 such cases. Exploration for diagnosis is obligatory if carcinoma of the lung cannot be positively excluded by other means.

Pneumonectomy by anterior approach is the treatment of choice. Operability is discouragingly low and resectability even lower; among 29 per cent of 2,034 cases of primary malignancy from the literature operation appeared feasible, but resection was possible in only 13.4 per cent. The more recent reports show a trend toward higher incidence, and of the 360 cases reported, 58 per cent were explored and 36 per cent resected.

Among the 360 cases of pulmonary malignancy diagnosed clinically, 109, or 30 per cent, were clearly inoperable. Of the 251 patients regarded as operable 41, or 16 per cent, refused surgery. Of the 210 cases explored, 81, or 38 per cent proved inoperable, leaving 129 (61% of those explored, or 36% of the total series) in which resection could be done.

Postoperative infection (empyema) occurred in 15 of the 129 cases, or 11.6 per cent. In 5 instances (3.8%) the infection was the result of a blown bronchus. Ten of the patients with postoperative infection died. Chemotherapy in the authors' hands has not materially influenced the morbidity in postoperative infection.

Among the 81 cases explored but not resected, there were 14 hospital deaths (17.3%). In the resectable group of 129, there were 32 hospital deaths (24.8%). The total operative mortality risk then was 22 per cent. Although the operative mortality was high, the mortality in absence of operation is 100 per cent.

Prior to 1942 the hospital mortality was 44.5 per cent and since 1942 it was 19.6 per cent. The average postoperative hospital stay prior to 1942 was 32 days and after 1942, 13 days.

Of the 107 patients resected, only a little over one-half (54%), survived 6 months. Six (22%) of 27 resected patients were alive at the end of 5 years. When hospital deaths were excluded, the survival rate of those operated 5 years or more ago was 40 per cent. None with extension of the lesion survived longer than 4 years after operation. If only those with localized lesions were included, the 5 year survival rate was 50 per cent. If a person lives through the third year after operation, he has a very good chance of being alive at the end of 5 years, for the distribution curve of survival rate by the third year has been stabilized and continues almost as a plateau until the fifth year.

Among the 107 patients resected, 38.7 per cent had extension at the time of resection.

When survival rates were calculated according to the year of operation, it was found that the rate of survival in each postoperative year improved after 1942 as compared to before 1942. This perhaps reflects improvements in technique. This improvement is shown in patients both with and without localization of the malignancy.

At the present time, only 36 per cent of the patients with clinical cases of carcinoma of the lung are resectable and of these only 8 per cent survive 5 years or more. Twenty-two per cent could enjoy a 5 year survival if diagnosis was made early enough to permit resection. FRANK B. QUEEN, M.D.

Rienhoff, William F., Jr.: The Present Status of the Surgical Treatment of Carcinoma of the Lung. *Ann. Surg.*, 1947, 125: 541.

Three hundred and twenty-seven patients with carcinoma of the lung have been operated upon since the first pneumonectomy was performed at Johns Hopkins Hospital 13 years ago. Total pneumonectomy was done in 112 (34%), but 215 (66%) were inoperable at time of exploration.

There was no operative mortality from exploration alone. The operative mortality from pneumonectomy (all deaths occurring within 1 month of operation regardless of cause were included) was 22 per cent. The postoperative mortality from pneumonectomy has improved from 27 per cent prior to 1939 to 21 per cent since 1939.

Twelve patients have survived 5 years or more. While the statistics presented do not present an accurate calculation of the 5 year survival rate, approximately 30 per cent of the patients subjected to pneumonectomy prior to 1941 (40) survived 5 years, or about 9.4 per cent of the 128 patients explored or pneumonectomized during this period.

Sixty-nine of the patients resected are now dead. However, these lived an average of a little over 1 year following pneumonectomy. (If the 25 postoperative deaths are excluded, longevity following pneumonectomy of the remaining 44 averages 1.6 years.) The 205 patients who were explored lived for an average of only 5 months following exploration. Thus longevity even in patients not cured is materially increased by resection.

In 70 per cent of the pneumonectomy cases there were metastases to the bronchial or tracheal lymph nodes. Sixty-five per cent of the cases were squamous cell carcinomas and 35 per cent were adenocarcinomas, including pleomorphic and oat cell cancers. The adenocarcinoma is the more malignant type. The cancer was near the hilus in 90 per cent and in the periphery (silent areas) in 10 per cent.

The roentgenograms were positive in every instance of the 327 cases. Positive biopsies were obtained in 70 per cent. The sex ratio was 6 to 1 in favor of the males. The right and left lungs were involved in about the same incidence.

Symptoms of cough were present in 71 per cent, hemoptysis in 63 per cent, and pain in 50 per cent. Exploratory thoracotomy "is imperative if a definite diagnosis cannot be obtained by other means."

The most important preoperative preparation is the induction of artificial pneumothorax to allow for adjustment of the cardiovascular system. One stage total pneumonectomy by the anterior approach is the operative procedure of choice. The bronchial stump is approximated with interrupted mattress sutures from 1 to 2 cm. proximal to the amputation and a pedicled flap of pleura is sutured over the viable stump. The stump lumen is cleared of blood clot or tumor tissue before closure and the patient is again examined with the bronchoscope before he leaves the table. Penicillin is used both preoperatively and postoperatively.

In the discussion RIENHOFF also mentions 4 patients operated upon for solitary metastasis: 2 by himself for metastatic fibrosarcoma from the tendon sheath of the thigh and 2 by Blalock for simple metastases from the colon. FRANK B. QUEEN, M.D.

Domenico, P.: Pleuropulmonary Sclerosis of the Apex (Le cicatrici pleuro-polmonari dell'apice). *Minerva med.*, Tor., 1947, 38: 348.

This discussion of the etiology and prognosis of cicatricial lesions of the apex is based on the histological studies of 5 patients dying of unrelated disease in whom no history of tuberculous infection was obtainable. In all of the cases the sections showed rather dense fibrous tissue with peripheral areas of emphysema. There were no traces of tuberculosis.

There is little doubt as to the tuberculous origin of these sclerotic areas and the absence of tuberculous elements excludes the possibility of reexacerbation. EDITH B. FARNSWORTH, M.D.

HEART AND PERICARDIUM

Taussig, Helen B.: Diagnosis of the Tetralogy of Fallot and Indications for Operation. *J. Thorac. Surg.*, 1947, 16: 241.

The four features which characterize the tetralogy of Fallot are pulmonary stenosis or atresia combined with dextroposition of the aorta, a high ventricular septal defect, and right ventricular hypertrophy.

The characteristic clinical findings are cyanosis and clubbing, a heart of normal size, usually a basal systolic murmur, and a pure second sound. The electrocardiogram shows a right deviation. The x-ray shows an absence of the normal fullness of the pulmonary conus and clear lung fields. Fluoroscopy shows no pulsations at the hilus of the lungs.

There are many variables. The systolic murmur may be quite loud, or entirely absent. The second sound may be diminished or accentuated; it is never reduplicated. Cyanosis may be marked or slight, according to the degree of the oxygen unsaturation and the height of the red blood count. The oxygen saturation of arterial blood is also subject to great variation (from 88 to 10 per cent). It varies from individual to individual according to the severity of the pulmonary stenosis, and also in the same individual from day to day. The exercise tolerance of the individual shows a corresponding variation: some persons can walk a mile, some not at all. Operation is indicated for those who are severely handicapped.

The operation is designed to increase the circulation of the lungs. It consists of an anastomosis between the proximal end of one of the systemic vessels to the side of one of the main pulmonary vessels. The operation is indicated only in cases in which the primary difficulty is lack of circulation to the lungs. It is possible only when there is a pulmonary artery to which to anastomose the systemic artery and the pressure in the systemic artery is

higher than that in the pulmonary artery, and, finally, when the size and structure of the heart is such that it can adjust itself to the altered circulation. Fluoroscopy aids in the determination of the size and structure of the heart. The heart should not be enlarged. There is no fullness of the pulmonary conus and no pulsations in the lung fields. Usually there is an absence of hilar shadows. However, in patients with extensive collateral circulation these shadows may become pronounced but are composed of an aggregate of fine shadows and never show expansile pulsations.

The diagnosis of a right or left aortic arch is of importance because the position of the aorta determines the side upon which the operation is performed. A right aortic arch occurs in 20 per cent of the patients with a tetralogy of Fallot. In all such cases the innominate artery lies on the left. Indeed, the innominate, if present, lies on the opposite side to that upon which the aorta descends, and, furthermore the subclavian artery is given off from the innominate artery at a better angle for anastomosis than it is from the aorta. Therefore, the operation is usually best performed on the opposite side from the aortic arch.

The course of the aorta is determined by fluoroscopy or roentgenography. Often the normal aortic knob is visible on the left. The right aortic knob is often hidden by a ribbon of the superior vena cava. Delineation of the esophagus with an opaque barium mixture usually clarifies the position of the aorta. Normally, the esophagus descends in the midline, and is indented to the right on its left margin, whereas if the aorta arches to the right and descends upon the right, it indents the right margin of the esophagus to the left and the esophagus lies to the left of the midline. Normally, in the right anterior oblique position, the esophagus hugs the cardiac shadow and is slightly displaced backward by the aorta, whereas in cases of a right aortic arch, the esophagus is independent of the aorta in the right anterior oblique position.

The factors influencing selection of patients are: (1) the age and size of the patient, (2) the severity of the anoxemia, and (3) the height of the red blood count, hemoglobin, and hematocrit.

The optimum age for the patient is between 5 and 10 years. The use of the subclavian artery for the anastomosis is a sounder and far less dangerous operation than the use of the innominate artery. The subclavian artery in an infant is always extremely small; therefore, operation is not indicated in infancy unless it appears that the infant is going to die.

However, if the patient is in danger of dying of anoxemia, early operation is clearly indicated. Attacks of dyspnea are common and are often severe in patients between 4 and 18 months of age. Prolonged syncope is an indication for operation.

The degree of incapacity varies greatly. With an oxygen saturation of 30 per cent most children can walk only a few feet. With an oxygen saturation of from 20 to 25 per cent few can walk at all; when it is below 20 per cent there is cause for great concern.

The height of the red blood count, hemoglobin, and hematocrit is important in the selections of the patients. If the red blood cell count is between 8 and 10 million, or the hematocrit between 70 and 80 mm., the patient is in great danger of cerebral thrombosis. For such children operation is indicated. Inasmuch as dehydration increases the danger of thrombosis prior to operation, these children should receive from 1.5 to 2 quarts of liquid a day. Twelve hours of dehydration is liable to cause cerebral thrombosis; therefore, great care should be used not to dehydrate the child the night before operation, especially if the operation is not done early in the morning.

Results of operation are immediate improvement in the patient's color, prompt rise in oxygen saturation of the arterial blood, and the gradual fall in red blood count, hemoglobin, and hematocrit. The rapidity of the fall of the red blood cell count depends upon the amount of blood lost at operation. Once the anastomosis is established there is no need for the polycythemia. Although heresy to the surgeon, venesection at the end of operation is a sound physiological procedure. It lessens the load placed on the lungs. The heart is not normal. There is a loud, continuous murmur, but the patient looks like a normal individual. It is not yet possible to say how much we have increased the life span of the patient, but his enjoyment of life is greatly increased. There is gradual disappearance of clubbing of the extremities and a great increase in exercise tolerance. The child can measure his activity not in terms of walking a few feet but in terms of miles.

JOHN J. MALONEY, M.D.

Blalock, Alfred: The Technique of Creation of an Artificial Ductus Arteriosus in the Treatment of Pulmonic Stenosis. *J. Thorac. Surg.*, 1947, 16: 244.

The technique by which one may create an artificial ductus arteriosus in the treatment of pulmonic stenosis is described. The ages of the patients ranged from 2 months to 26 years. Operation was performed on 144 patients, with an over-all mortality rate of 22 per cent. This total includes several patients in whom the pulmonary artery was absent or was so abnormal that it could not be found at the time of operation.

An anastomosis was performed between the end of a systemic artery and the side of one of the two main pulmonary arteries in 118 patients, with 18 deaths, a mortality of 15 per cent. The subclavian artery was used in 72 of these with 5 deaths, a mortality of 7 per cent. The carotid artery was used in 11 cases with 1 death, a mortality of 9 per cent. The innominate artery was employed in 36 patients with 12 deaths, a mortality of 33 per cent. The author has practically abandoned the use of the innominate artery in patients who are 2 years of age and older.

An end to end anastomosis was attempted in 13 patients, with 6 deaths. In 5 of the fatal cases the pulmonary artery was too small for a satisfactory anastomosis. In the remaining case the condition was improved following the operation but death occurred suddenly 6 months later from an unexplained cause.

With 1 exception, all of the patients in whom an anastomosis was performed and who are living are believed to have been benefited. In the exception the intima of the subclavian artery was damaged and thrombosis occurred. There has been no mediastinitis, no empyema, no severe bleeding from the anastomotic line, and, thus far, no bacterial endarteritis.

JOHN J. MALONEY, M.D.

ESOPHAGUS AND MEDIASTINUM

Frink, Norman William: Spontaneous Rupture of the Esophagus. *J. Thorac. Surg.*, 1947, 16: 291.

A case is presented in which the patient recovered following a spontaneous rupture of a previously normal esophagus.

Diagnosis and treatment are discussed.

The reason that patients with spontaneous rupture of the esophagus die so quickly is still unexplained. Unquestionably, the sudden forceful onslaught of chemical and infective mediastinitis and pleuritis is the most important factor. Just what effect this produces on the adjacent sympathetic nerves and plexuses is largely conjecture. The patient may survive the first few days, if the infection is not overwhelming, only to succumb to a massive hemorrhage from the site of the rupture when he seems to be on the road to recovery.

Because the condition is so rare and so few cases have been diagnosed during life, the literature contains but few recommendations as to therapy. Williams and Boyd suggested early thoracotomy drainage. This is also suggested by Vinson. Benson and Penberthy reported a case of rupture of an esophageal ulcer into the pleural cavity which was treated by closed drainage of the empyema; the patient recovered. Eliason and Welky recommend posterior mediastinotomy. This would appear to be the procedure of choice if the infection were limited to the mediastinum. If an empyema is present, the author recommends closed intercostal drainage, preferably with constant suction. This would tide the patient over his initial toxicity. When his condition had improved sufficiently and it was believed that the mediastinum was well fixed, open thoracotomy would be done.

Surgical repair of the esophagus following spontaneous rupture has been attempted but once. In this instance the patient expired 21 hours after operation. This is truly a formidable procedure to perform on a desperately ill patient, and to be successful would have to be done within a few hours after the rupture had occurred; however, this is when an accurate diagnosis is most difficult. It would seem that these early hours might better be spent in attempting to resuscitate the patient by means of sedation, oxygen, parenteral fluids, and transfusions, with surgery limited to simple drainage of the infected region.

In the light of our present knowledge of chemotherapeusis the administration of penicillin in large doses is definitely indicated. At the same time, one of the sulfonamide salts given intravenously might be a worth while adjunct to penicillin. The efficacy of these drugs, of course, depends entirely upon the bacterial flora present.

Esophagoscopy is not recommended. Observation of a swallow of barium sulfate mixture under the fluoroscopic screen would give the same diagnostic aid as esophagoscopy with none of the disadvantages of the latter.

The use of a nasal feeding tube is open to strong criticism because of the possibility of producing further injury by the passage of the tube and the irritation the tube would theoretically produce by residing over the site of rupture. Possibly these dangers are not as great as they might seem. If it is used a chest roentgenogram should be taken immediately after the tube is passed to determine its position. Vinson has reported a case in which the tube was visualized looped outside of the esophagus into the mediastinum.

Whether or not a gastrostomy or jejunostomy should be done for feeding purposes is a moot question. Again, this is a major operative procedure for a critically ill patient. Probably those patients who survive the first few days would recover without it if a fatal hemorrhage did not intervene. The patient could well be supported during the initial few days with fluids given intravenously and subcutaneously. As soon as the patient's condition permits, it is recommended that a jejunostomy be performed. This would place the esophagus at rest as much as possible while at the same time it would provide a means of supplying much needed nutrition. This is much to be preferred to gastrostomy, as it would obviate the danger of a reflux of food through the rent in the esophagus. In a few cases coming to autopsy it was noted that the esophageal rupture extends into the stomach. It thus seems advisable to keep the stomach, as well as the esophagus, as empty as possible.

It would be well to have compatible blood kept in readiness in a "bank" or refrigerator so that it might be administered with no delay if hemorrhage occurs. The danger of this secondary hemorrhage is greatest during the first week or two. If the blood is ready and instantly available, its use may well prevent a fatality.

If the patient recovers, he should be checked at intervals of a few weeks or months by means of barium studies of the esophagus because of the possibility of subsequent stricture formation. If a stricture did occur, treatment could be started early before obstruction intervened.

With the exception of 2 cases mentioned by Graham, this is the first case of recovery following spontaneous rupture of the esophagus to be reported. If the entity of rupture of the esophagus is borne in

mind, many more cases should be diagnosed before death. Undoubtedly the mortality rate will always be high but if the diagnosis can be made early enough and prompt treatment begun, more and more patients should recover. JOHN J. MALONEY, M.D.

Bozzi, E., and Cova, P. L.: Polypoid Tumors of the Esophagus (Sui tumori poliposi dell'esofago). *Radiol. med.*, Milano, 1947, 33: 161.

In a 2 year period at the National Institute for the Treatment of Tumors in Milan, 7 esophageal polypoid tumors were observed. Six of these could be examined histologically, but the remaining growth broke off and disappeared before endoscopy could be instituted. In 4 of the 6 patients the histologic diagnosis was polymorphocellular sarcoma, adenocarcinoma, papillary fibroepithelioma of Malphigian cell type (precancerous stage), and nondifferentiated carcinoma, respectively. In the remaining 2 histologically studied cases the diagnosis could not be confirmed with certainty because in the first endoscopic manipulations the pedicles were so injured that the tumor broke off and fell into the stomach before more complete biopsy studies could be done. One of these was considered to be a fibroma or a fibromyoma (benign), and the other exhibited some leucoplasia and was thought to be a simple chronic pharyngitis with polypoid development.

In none of the 3 benign cases was the tumor removed, and yet the patients are still alive and well after 1 year, 1 year, and 3 years, respectively. Of the 4 malignant cases, 2 received no treatment because of the grave condition of the patient (hemorrhage, exhaustion), and the other 2 received roentgen therapy. In the case of adenocarcinoma 8,000 roentgens produced an initial improvement with regression of the tumor; 2 months later, however, the tumor returned with severe manifestations of dysphagia and pain which ended in death. At present all 4 patients with malignancies are dead. Nevertheless, the irradiated cases manifested an evident radiosensitivity of the tumor cells.

From their own experience—meager it is true—and a rather fragmentary review of the literature, the authors conclude that there are no constant signs, either roentgenological or endoscopical, which permit a certain differentiation between the benign and the malignant polyp. This differentiation will ultimately rest upon biopsy, and is particularly important because of the difference in prognosis and treatment of the two conditions. For the malignant case the authors prefer roentgen therapy, while they attempt removal of the benign tumor. However, they concede that, even in the case of a malignant new growth the removal of the whole or a part of the intraesophageal obstructing mass may afford palliative relief. Because of the necessity of respecting the thinned and stretched esophageal wall at the point of attachment of the polyp, the authors believe that the deliberate, though not brutal, endoscopic manhandling of the pedicle with the intent of injuring it to the point where it will later give way spontaneously is justified.

Surgical intervention by the external route is to be considered only in the presence of a benign polyp of particularly voluminous character. In the external approach in the malignant case it is admitted that there is a chance, by removing the entire circumference of the esophagus itself, of removing the condition before it has spread through the esophageal walls; however, such an operation is to be attempted only in special centers with the aid of especially experienced personnel.

JOHN W. BRENNAN, M.D.

SURGERY OF THE ABDOMEN

ABDOMINAL WALL AND PERITONEUM

Gaston, Eugene A.: Living Fascial Sutures in Inguinal Herniorrhaphy. *Arch. Surg.*, 1947, 54: 414.

The author presents a personal series of 201 inguinal hernias treated most proficiently by the use of living fascial sutures. His follow-up statistics are carefully documented and his recurrence rate is only 1.74 per cent.

The anatomy and physiology of the inguinal region are clearly and simply reviewed, particularly in the light of the recent work of Anson and McVay. The pathologic changes in both direct and indirect inguinal hernias are discussed, and their structural similarities in regard to herniorrhaphy are stressed.

A technique for the surgical repair of inguinal hernias is explicitly described, in which the following points are significantly emphasized: (a) an adequate incision, (b) ample exposure and painstaking repair of the transversalis fascia, and (c) broad approximation of the internal oblique muscle to the inguinal ligament, lateral as well as medial to the internal ring, by means of a combination of silk and living fascial sutures. The fascia used is a strip of the external oblique aponeurosis as shown in Figures 1 and 2.

The operative mortality rate was 0.5 per cent, 1 death occuring in a patient with a strangulated direct hernia who had peritonitis and a pulmonary infarct.

These personal case records kept by the author were indeed conspicuous by their comprehensiveness and detail. For example, the difference in the insertions of the internal oblique muscle was carefully noted in most cases, as was the condition of this muscle relative to age, duration of the hernia, and the wearing of a truss.

Complications are discussed and a detailed summary of results is unequivocal and to the point.

EDWARD F. LEWISON, M.D.

GASTROINTESTINAL TRACT

Maimon, S. N., Bartlett, J. P., Humphreys, E. M., and Palmer, W. L.: Giant Hypertrophic Gastritis. *Gastroenterology*, 1947, 8: 397.

A review of 5,765 gastroscopic examinations carried out at the University of Chicago Clinics revealed 6 cases of giant hypertrophic gastritis, verified at operation. Four other cases were diagnosed on the basis of x-ray and gastroscopic findings, 2 being confirmed by operation—an incidence of 0.17 per cent. The cause is unknown. The gastroscopic findings, the pathology, and the histologic observations in each of the cases are discussed in detail.

From the standpoint of the clinical diagnosis, the differentiation of giant hypertrophic gastritis from carcinoma by roentgenography or by gastroscopy in the cases presented was unsatisfactory. In 2 of the 6 cases of giant hypertrophic gastritis a superimposed hyperplastic polyp formation was observed. Considerable difficulty was encountered in differentiating this condition from neoplasm. Anatomically, roentgenologically, and gastroscopically, the resemblance of the gastric folds to the convolutions of the brain is striking and is perhaps the most salient feature.

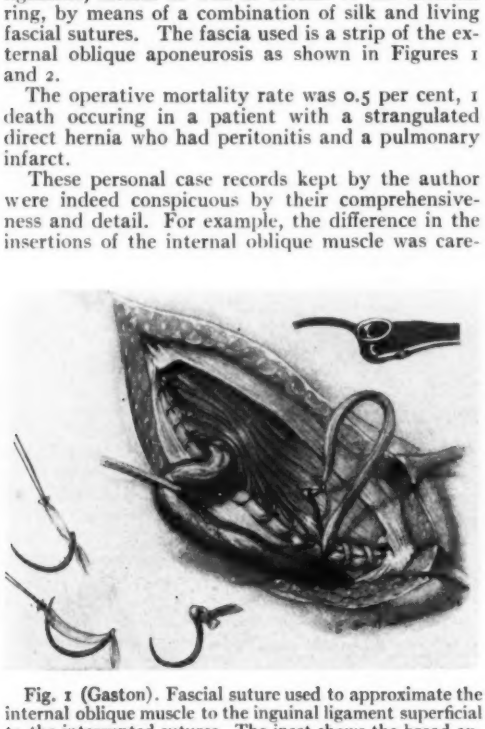


Fig. 1 (Gaston). Fascial suture used to approximate the internal oblique muscle to the inguinal ligament superficial to the interrupted sutures. The inset shows the broad approximation thus established.

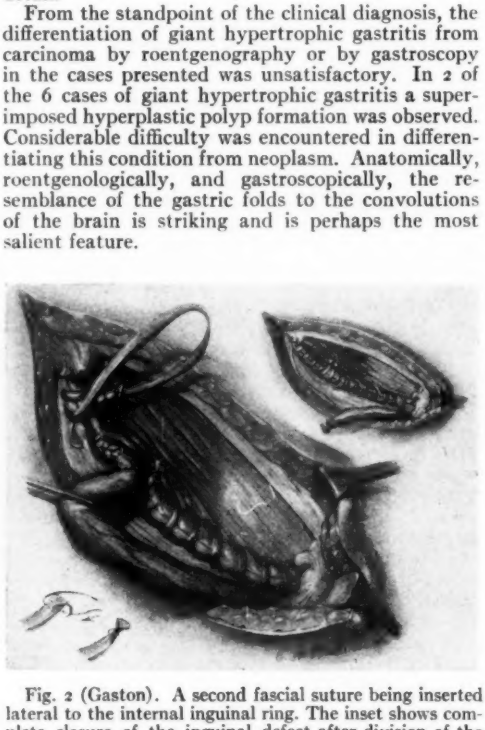


Fig. 2 (Gaston). A second fascial suture being inserted lateral to the internal inguinal ring. The inset shows complete closure of the inguinal defect after division of the spermatic cord preparatory to orchiectomy.

Histologically, redundancy of the mucosa and marked hypertrophy of the glandular structures are outstanding features with cyst formations and metaplasia to the intestinal type of epithelium.

RICHARD J. BENNETT, M.D.

Johansson, O.: Two Hundred Cases of Perforating Peptic Ulcer of the Stomach and Duodenum (200 Falle von perforierenden Magen- und Duodenalgeschwüren). *Acta chir. scand.*, 1947, 95: 233.

The author gives a statistical report of 200 cases of perforating peptic ulcer of the stomach and duodenum observed in the surgical department of the Central Hospital at Gefle, Sweden, in the period from 1930 to 1944. Eighty-eight per cent of the patients were men and 12 per cent were women. During this period of 15 years, the mortality dropped from 21 per cent in the first 5 years to 8 per cent in the last 5 years in the cases of men, whereas in the women it remained practically unchanged from 40 to 50 per cent. No explanation is offered for this surprising fact. The prognosis depends on 2 factors: the age of the patient and the time interval between perforation and operation. In patients under 60 years of age the prognosis is excellent if they are operated on within 6 hours after perforation. If surgery is performed between 6 and 24 hours after the perforation, the prognosis is comparatively good in persons under 40 years of age. Perforations older than 24 hours offer a poor prognosis, even in younger patients.

In 13 per cent of the cases, perforation occurred without any previous history of ulcer. One hundred and fifty of the cases were examined roentgenographically. Only 77 per cent of these showed the classical sign of free gas in the peritoneal cavity. The method of operation was usually suture or excision, with or without a Witzel fistula. The author believes that excision of the ulcer is preferable to simple suture as with the latter method the incidence of relapse was higher. Primary resection is too risky. Resection should be performed only as a secondary operation if ulcer symptoms remain after the primary excision or suturing.

WERNER M. SOLMITZ, M.D.

Tonini, G.: A New Sign of Appendicitis (Su di un nuovo segno di appendicite). *Rass. internaz. clin. ter.*, 1947, 27: 139.

Consolandi illustrated a new clinical sign of appendicitis, and the author discusses his experience with it.

In a good percentage of cases he was able to note, with the use of a tangent light, two transverse cutaneous folds, one superior and one inferior, on the abdominal wall in the suprapubic region. In cases of appendicitis the superior cutaneous fold fuses with the inferior fold on the right side, but on the left side the folds are undisturbed; this produces an assymmetry of the abdominal wall.

This phenomenon may have a double origin: (1) anastomosis of the lymphatics between the ileocecal portion of the intestine and the lymphatics of the abdominal wall which produces edema of the abdominal wall; and (2) a nerve reflex arc from the inflamed appendix, which produces a motor paresis of the inferior quadrant of the abdominal wall on the right.

In a study of the clinical sign of Consolandi in 63 patients with symptoms of an acute abdomen, the author observed the absence of the cutaneous fold in 13, while of the 50 with the fold, 29 presented a positive sign and 21 a negative one. Surgical intervention confirmed the existence of the clinical sign.

ARTHUR F. CIPOLLA, M.D.

Michel, Marshall L.: Acute Malignant Obstruction of the Large Bowel; An Analysis of 55 Cases. *South. Surgeon*, 1947, 13: 299.

Fifty-five cases of acute complete obstruction were found among 203 cases of carcinoma of the large bowel seen at the Charity Hospital over a 3 year period and at the Touro Infirmary over a 6 year period, a 27 per cent incidence. The 55 cases were managed by 25 different surgeons and treated as follows:

TABLE I.—TYPE OF TREATMENT

Type of treatment	No. of cases	No. of deaths
Conservative	3	2
Immediate resection	10	5
Cecostomy	24	6
Sigmoidostomy	2	0
Ileostomy	2	2 (both almost moribund)
Ileotransverse colostomy	10	2
Devine colostomy	3	1
Drainage of paracecal abscess	1	0

The mortality rate was 30 per cent.

Transverse colostomy is regarded as the procedure of choice in carcinoma of the left colon, while ileostomy or ileotransverse colostomy in selected cases is the procedure of choice in carcinoma of the right colon.

About 90 per cent of all obstructions of the large bowel are of malignant origin. About one-third of all patients with large bowel cancer eventually develop complete or "chronic" obstruction. The average age for this series was 55.8 years and the age range from 13 to 86 years.

In 41 of the 55 cases (75%) the obstruction occurred in the left colon. The reasons for this are believed to be:

1. The lumen of the left colon is generally smaller than that of the right and its walls are thicker and less distensible.

2. The fecal content is more solid in the left than in the right colon, and hence may traumatize the malignancy more readily and cause secondary infection, ulceration, and edema.

3. The annular type of carcinoma occurs somewhat more frequently in the left colon than in the right colon.

In the light of the current emphasis that salvation in malignant disease rests, in the last analysis, with the patient and depends upon his consulting the doctor early, it is as ironic as it is tragic that 12, or 22 per cent, of these patients did seek medical aid at intervals varving from 1 to 18 months prior to obstruction. Three of them were told to take purgatives; 1 was given medicine; 1 was treated 7 months for dysentery; 1 was told he had a gastric ulcer; and another was told that the symptoms were due to "womb trouble."

Four had been operated upon—2 had appendectomies 2 weeks and 15 months before entering the hospital; 1 had a cecostomy for "volvulus" of the cecum 3 months prior; and 1 had had "release of adhesions" 18 months prior. FRANK B. QUEEN, M.D.

LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

Snell, A. M.: Jaundiced Patients. *J. Am. M. Ass.*, 1947, 133: 1175.

Success in the management of jaundiced patients appears to depend on increased accuracy of diagnosis, especially in the differentiation of obstructive from hepatocellular jaundice. The value of "profile" hepatic functional studies, especially those concerned with urobilinogen metabolism, is discussed.

The indications for surgical intervention in cases of jaundice include (1) the proved or presumed presence of stone, (2) the development of jaundice after cholecystectomy, (3) the presence of associated biliary fistulas, and (4) proved complete acholia. The relative contraindications for surgical treatment are discussed with reference to the signs and symptoms of serious primary or secondary hepatocellular injury.

The established principles of medical treatment include a highly nutritious diet, the maintenance of normal hemoglobin and protein levels, the use of vitamins for the correction of specific deficiencies, and the employment of lipotropic substances and liver extract.

Ferguson, L. K., and Anderson, R. K.: Amebic Liver Abscess in Service Personnel. *Gastroenterology*, 1947, 8: 332.

With the return of the armed forces who have been on duty in areas in which the incidence of amebiasis is high, the appearance of the disease and its complications may be expected to increase.

From a surgical point of view, the most important complication of amebiasis is liver abscess. Many abscesses progress, without recognition, to more serious complications. Perforation through the diaphragm to involve the pleural cavity is usually a late complication and was not seen in the authors' cases. The more common complication is secondary infection of the abscess with pyogenic organisms. Frequently, the acute symptoms of a pyogenic infection are the presenting complaints. In the present series, the time from the amebic colonic symptoms to those of liver abscess varied from 1 month to 1 year.

The authors have seen no extension of the amebic or infective process from aspiration or drainage in cases in which emetine and penicillin were used in the postoperative period.

A two stage transdiaphragmatic procedure is used. The abscess is located by exploring with an aspirating needle, under local anesthesia, at the site of the most acute local tenderness produced by fist percussion or deep intercostal pressure. A large, long needle should be used. When pus is found, a small amount is aspirated, enough to relieve tension in the abscess, and to serve for smear and bacteriologic study. The needle is detached from the syringe and left in place, and the rib above or below the needle is resected subperiosteally for a distance of about 2 inches. Care should be taken not to injure the underlying pleura. The wound thus produced is tightly packed with iodoform gauze, the aspiration needle is then removed and a tight dressing applied. After an interval of 3 or 4 days, the patient is returned to the operating room and, under local anesthesia, the iodoform packing is removed. The parietal and diaphragmatic pleuras are now adherent, and transdiaphragmatic drainage may be carried out without danger of infecting the pleural cavity. The exploring needle is again used to locate the abscess cavity, and with this as a guide, the abscess is opened through the diaphragm. Once pus is located, an aspirator is used to evacuate the contents of the cavity and the opening is enlarged sufficient to permit the introduction of one or two large rubber drainage tubes. An iodoform pack is used to control the ooze by introducing it along the tubes into the abscess cavity and in the wound.

The diagnosis is not always easy because the demonstration of ameba in the stools may be difficult, the history indefinite, and the period from dysentery to abscess considerably long.

Four case reports are included which illustrate the difficulties of diagnosis. JOSEPH GASTER, M.D.

Duckett, J. W., and Montgomery, H. G.: Resection of Primary Liver Tumors. *Surgery*, 1947, 21: 455.

Recent advances in our knowledge of the physiology of the liver and gradual accumulation of clinical data from reports of surgical cases have fairly well eliminated the fear of producing insufficiency by removal of large portions of this organ. The right and left branches of the hepatic artery anastomose freely so that if either main branch is divided during the course of resection, the intact branch can adequately supply the remaining portions of the liver. However, extreme care must be taken to avoid damage to the main hepatic artery. Even temporary compression of the hepatic artery produces symptoms of shock, and consequently this method of control of hemorrhage from the liver is unsuitable.

The method of controlling hemorrhage described by Pickrell and Clay is the use of a line of interlock-

ing mattress sutures passing through the liver substance proximal to the line of incision in the liver. These are placed prior to the incision of the liver, for the purpose of immediate control of bleeding by compression.

The author reports 3 cases. In all 3 the tumors were hepatomas, liver cell tumors of low grade malignancy. The first patient, a man of 73 years who is alive and well after 22 months, had a resection of the entire left lobe. Resection of the left lobe proved to be easier technically than resections of portions of the right lobe. In the second case, that of a child 3 years of age, a huge tumor of the left lobe and invading the right lobe, was successfully resected, but the patient died 6 months later with recurrence of the tumor. The third patient, a child 20 months of age, had a much smaller tumor of the right lobe, and had a much more favorable prognosis.

LEE PULLEN, M.D.

Hoyne, Robert M., and Kernohan, James W.: Primary Carcinoma of the Liver; A Study of 31 Cases. *Arch. Int. M.*, 1947, 79: 532.

Primary carcinoma of the liver is a rare disease. Thirty-one cases have been found in 16,303 autopsies at the Mayo Clinic, an incidence of 0.19 per cent. Six of these cases had been previously reported in the literature. The disease occurs most commonly in the Orient and South Africa. A series of reports collected from the literature reveals an incidence of 0.227 per cent among the white-skinned races of Europe and America, and an incidence of 0.983 per cent among the Asiatic and African races. This increased tendency of the disease to afflict the latter peoples is believed to be due to the high geographic incidence of schistosomiasis and clonorchiosis among these peoples and to the chronic irritation of the liver caused by these parasitic infections.

Primary carcinoma of the liver is a disease of older persons. In most of the authors' cases the lesion occurred in the fifth, sixth, and seventh decades of life. In 23 of these 31 cases the disease occurred in males, the sex which is more frequently afflicted. Primary carcinomas of the liver arising from liver cells are called "hepatomas," and those arising from bile ductules are called "cholangiomas." Reports of hepatomas in the literature far exceed those of cholangiomas. In 20 of the 31 cases the tumors were hepatomas and in 11 they were cholangiomas. Cirrhosis frequently is associated with primary carcinoma of the liver, and undoubtedly is an important causative factor. In 15 of the 20 hepatomas (75 per cent) cirrhosis was associated, but it was present in only 2 of the 11 cases of cholangiomas (18.2 per cent).

It is still debatable whether the incidence of primary carcinoma of the liver is any greater in the presence of hemochromatosis than it is when nonpigmentary cirrhosis alone is present. There are no pathognomonic clinical or laboratory signs or symptoms in these cases, and the diagnosis is rarely made before death of the patient. The most significant symptoms and signs in the cases were emaciation, abdominal distention with ascites, abdominal pain, edema of the ankles, jaundice, and a palpable abdominal tumor.

Gross distinction between hepatoma and cholangioma usually is difficult, and the final diagnosis must be made histologically. The question of multicentric or unicentric origin of these tumors is still debatable; most authors favor the latter view. Eleven of the 20 hepatomas were characterized by obvious invasion of the blood vessels. The early vascular involvement is thought to cause the intrahepatic metastasis so often seen in the presence of hepatoma. Tumor thrombosis of the inferior vena cava and right auricle may accompany these tumors. In 21 of the 31 cases, 67.7 per cent, extrahepatic metastasis was present. Cholangioma, as a rule, metastasizes earlier and more frequently than does hepatoma. The tumors under consideration grow exceedingly rapidly and the prognosis usually is hopeless. Early surgical resection of the liver offers the only chance for cure in these cases.

Baker, H. L., and Caldwell, D. W.: Lesions of the Ampulla of Vater. *Surgery*, 1947, 21: 523.

The report concerns itself with 4 different lesions of the ampulla of Vater which have been observed in the past 3 years. The conditions are (1) cystic dilatation of the common bile duct, (2) benign papilloma of the ampulla, (3) adenocarcinoma of the ampulla, and (4) ulcer of the duodenum affecting the ampulla.

It is well to recognize that only at operation can cystic dilatation of the common bile duct be regularly differentiated from the more frequent, less hopeful malignant neoplasms. The condition appears almost entirely in childhood or young adulthood, and is most frequent in females under the age of 25 years. Rolleston suggested the causes of cystic dilatation to be (a) idiopathic, that is, no obvious obstruction, considered to be due to a primary inherited weakness of the wall of the duct, and (b) obstruction at the distal end of the common duct due to congenital stricture, trauma, stones, or surgery, and infections such as syphilis, typhoid, and those resulting from a more heterogenous group of bacteria from the intestine. The condition is accompanied by symptoms and findings, such as recurrent jaundice and occasionally paroxysmal pain.

The importance of benign papillomas of the ampulla of Vater is obvious inasmuch as their differentiation from early malignant growths is not possible except at the time of surgical exploration. The further importance of such tumors is emphasized when one realizes that 70 per cent of the also rare carcinomas of the duodenum are located at the ampulla.

Accepted by some is the belief that primary carcinomas of the region of the ampulla of Vater start as benign papillomas. This is because of the similarity of the gross and microscopic appearance of benign tumors to that of the low grade papillary carcinomas. The question has been raised as to the possibility that ulceration of the periampullar duodenum is the precursor of such malignancies.

Most of the papillomas are of a columnar epithelial type and not of glandular formation. This is in contradistinction to the glandular type of formation of the carcinomas. The tumors are usually very small. They may be cystic or solid and consist usually of small hard white masses, often readily mistaken for an impacted calculus or a carcinoma. The most common symptoms and findings are those of painless jaundice, generalized pruritis, weight loss (due to retention of bile and loss of external pancreatic secretion), hepatomegaly, fever, and diarrhea.

Ampullar carcinoma is relatively rare. Adenocarcinomas of the region of the ampulla of Vater are the most common in this area. On gross examination in situ, these may readily be mistaken for small calculi or benign neoplasms. Therefore, they must be most closely scrutinized and biopsy made if at all possible.

Ulcer of the duodenum affecting the ampulla of Vater is a rather rare condition which may come about as the result of a primary ulcer in this region or as the result of marginal ulcers following various gastroedemic anastomoses for intractable ulcers of the stomach or first portion of the duodenum.

The author presented 4 cases, each of a different pathologic nature but with marked similarity of symptoms and findings, such as persistent jaundice, pruritis, anorexia, weight loss, and stool color changes. Because of such similarity and the great difference in prognosis, the following conclusion is expounded:

In those patients with biliary tract obstruction producing symptoms and physical findings which cannot be readily explained by the simpler, less hazardous means, the surgeon is thoroughly justified in exploring the ampulla of Vater transduodenally, and, in agreement with Brunschwig, transduodenal resection with reimplantation of the ducts with or without internal biliary drainage should be the choice for ampullar carcinomas of 1 cm. or less in diameter which appear quite circumscribed or show little gross evidence of infiltration and which do not extend into the pancreatic tissue. LEE PULLEN, M.D.

Bengoléa, A. J., and Negri, A.,: Disease of the Terminal Common Duct (La maladie du cholédoque terminal). *Rev. chir.*, Par., 1947, 66: 65.

The literature frequently makes mention of a functional alteration in the sphincter of Oddi as the cause of the persistence of symptoms following operations on the biliary tract, most often following cholecystectomy. Sphincteric spasm no doubt exists, but it does not account for all the postoperative difficulties not otherwise due to such entities as residual lithiasis, pericholangiitis, cicatricial stenoses, or extrinsic pathological processes. The more or less permanent nature of the symptoms, the inability to observe sphincteric spasm by cholangiography, the frequency of fever which precedes or accompanies the syndrome, and the futility of the use of biliary hypotensives all mitigate against a spasmodic mechanism as the primary cause.

Organic lesions in the duodenal portion of the common duct have been noted and studied microscopically by the authors. The primary lesion consists in hypertrophy and hyperplasia of the muscle of Oddi. The hypertrophy assumes a concentric form and thereby infringes upon the lumen of the duct. This alteration usually is caused mechanically from irritation derived from an adjacent inflammatory process such as duodenitis or diverticulitis. The hypertrophy is always followed or accompanied by a glandular hyperplasia which can become almost adenomatous. The hyperplasia develops toward the lumen so that in certain instances the lumen is so reduced that it almost disappears from the microscopic sections.

Inflammatory infiltration along with the fibrous involvement of the muscular tissue and mucosa is likewise notable. In all except 2 of the authors' cases, the infiammation was chronic and most marked in the mucosa which suggests that the mucosal infiltration is primary and the muscular infiltration secondary. In the later phases of the inflammatory process the deposition of additional tissue by fibrosis causes thickening and induration of the duct. Much of the glandular tissue becomes encased in fibrous tissue.

The presence of tissue edema in the distal common duct was striking in the authors' cases, suggesting that the participation of the serous process perhaps completes an otherwise incomplete obstruction.

This pathologic picture is produced both by lesions of the biliary tract and by lesions of adjacent organs. The presence of calculi in the common duct does not necessarily cause complete obstruction. Unless they promote an inflammatory response or become impacted their significance as a cause of obstruction is decreased.

Duodenal disease, particularly ulcer, duodenitis, and diverticulitis, may also provoke gross alterations in the terminal bile duct. Duodenitis, irrespective of origin, by progress of the irritation up the common duct, favors thickening and inflammation of its terminal portion. Strauss mentions 29 cases of chronic biliary stasis without stones which were caused by extension of an inflammation of the duodenum into the common duct with the production of thickening and fibrosis. Diverticulitis causes obstruction in a similar manner. In 1 of the authors' cases, complete obstruction of the common duct was caused by an infected diverticulum adjacent to the ampulla of Vater.

Infiammatory diseases of the pancreas which may partially stenose the common duct by compression may also cause anatomical changes in the terminal duct by extension of the inflammation.

The authors suggest that such anatomical changes exist in many patients complaining of biliary disease with or without lithiasis. Their existence constitutes an incomplete obstruction which will allow the passage of bile unless the balance is upset by some inflammatory process. The inflammation provokes congestion and edema which reinforces the pre-existent obstruction, and the passage of bile is completely blocked. The rise in temperature which al-

most always accompanies colic and icterus affords some basis for this statement together with the fact that various degrees of inflammation were found in all specimens which the authors examined.

Eppinger states that in certain dyskinesias, extravasation of plasma at the level of the terminal common duct can cause obliteration of the duct. Icterus, in effect, is caused by an edematous tumefaction of the ampulla of Vater. This process occurs whether or not calculi are present in the duct. Since the symptoms usually regress in spite of the persistence of a stone, it would appear that when no impaction is present, the calculi are not the direct cause of the obstruction. The dilatation of the duct is dependent upon the degree of hypertrophy of the sphincter. Stones, when present, act only indirectly by favoring the change in the musculature. Their role is secondary since dilatation frequently continues after the stone is removed.

ORVILLE F. GRIMES, M.D.

Lagerlöf, Henrik: Choledochal Denervation in Biliary Dyskinesia. *Acta chir. scand.*, 1947, 95: 297.

Reich, in 1940, suggested that the pain of biliary dyskinesia might be relieved by sectioning the intrinsic nerves of the biliary tract, thereby inducing a paresis of the sphincter of Oddi with consequent decrease of pressure in the common bile duct. In one cholecystectomized patient he showed that the intracholedochal pressure was reduced from 125 millimeters of water before, to 85 millimeters 10 days after, operation. Injection of morphine caused a precipitate rise to 220 millimeters, but because this was not maintained for several hours he concluded that the residual pressure of 85 millimeters was the result of duodenal tonus.

In the present study 15 cases of biliary dyskinesia were investigated. All but one of the patients had previously undergone cholecystectomy, and the second operation was primarily done to exclude stones in the common duct. The diagnosis of biliary dyskinesia was made on the similarity between spontaneously occurring biliary colic and pain induced by morphine. Also, since theoretically the simultaneous injection of morphine and secretin should lead to spasm of the sphincter of Oddi, stasis in the pancreatic and biliary ducts, and resultant pain and elevation of the serum amylase and bilirubin, a "morphine-secretin" test was done before and after choledochal denervation.

Choledochal denervation as carried out in all 15 cases consisted of the removal of a 2 cm. section from a rather large nerve trunk which was found to arise from the celiac plexus. This nerve which has been identified in anatomical studies (Latarjet, Perman) as the "nerf pancreaticocholedochein," courses behind the portal vein to the common duct in the area of the neck of the gall bladder, and from this point descends dorsally and medially to the duodenum. In all cases common duct exploration was carried out as well as section of the contiguous nerve trunk.

Following the choledochal denervation, pain was relieved in 14 of the 15 patients, and the rise of serum amylase and bilirubin in response to morphine and secretin was found to be lower than preoperatively. Although the relief of pain postoperatively may be due to interruption of the pain pathways and/or decrease of the tone of Oddi's sphincter, the author believes that the results of the morphine-secretin test indicate that the sphincter contracts less strongly.

The effects of choledochal denervation lasted only a few weeks to months, probably because of regeneration of the nerve fibers; hence the operation is of little practical value, and is not advised save in cases in which the biliary tract is explored on suspicion of choledochal stone or inflammatory changes in the remnant of the cystic duct, and in which no pathologic process is found.

WAYNE CAMERON, M.D.

Koller, Oddmund: Acute Interstitial Pancreatitis Provoked by Hemolytic Streptococci in Infected Food (Fish). *Acta chir. scand.*, 1947, 95: 358.

The author describes in detail 2 fatal cases of acute, interstitial, nonpurulent pancreatitis due to hemolytic streptococci isolated from specimens taken at operation and at postmortem examination. Both patients were elderly men who had shared board and lodging, and who developed at about the same time violent abdominal pain radiating to the back and accompanied by vomiting. Death occurred in 3 and 5 days, respectively, and at autopsy the findings in both cases were remarkably similar. In both there was a slight cloudy peritoneal exudate, a gelatinous edema of the duodenum, edema and hyperemia of the pancreas from which short chain hemolytic streptococci were isolated, and cerebral edema.

Follow-up inquiries revealed that 3 members of a household had eaten warmed-over halibut and had become ill the following day. Death occurred as described in 2 of the members, but the third person, after a 24-hour bout of abdominal pain and diarrhea, had recovered. Nearly 8 weeks after his illness the serum of this patient showed a high antistreptolysin titer which denoted a recent severe streptococcal infection.

The pathologic-anatomical picture of the 2 cases described is similar to that of Zoepffel's pancreatitis edematosa and Elman's acute interstitial pancreatitis which is usually interpreted as an aseptic process, possibly as the initial stage of acute pancreatic necrosis. The author points out that as the etiology of acute pancreatic necrosis is obscure, more careful bacteriological examinations should be carried out in cases of disease of this viscus, particularly as it has been shown experimentally that bacteria may play a decisive or a contributory part in activating the pancreatic enzymes. He considers it not illogical, therefore, to consider chemotherapy with a view to preventing secondary infections with consequent intensification of the process and septicemia.

WAYNE CAMERON, M.D.

Morhardt, P. E.: A New Syndrome; Congenital Cystic Pancreatitis and the Rh Factor (Un nouveau syndrome: la pancréatite kystique congénitale et le facteur rhésus). *Presse méd.*, 1947, 55: 243.

The author reviews the syndrome of congenital cystic pancreatitis and notes the case of an infant with this disease who had a brother born subsequently with erythroblastosis and icterus.

It is possible that a precipitin elaborated by the mother in the amniotic fluid is swallowed by the fetus and reacts with the fixed antigens of the bronchial glands, the pancreas, and the bowel, to which the amniotic fluid has free access during fetal life.

In the opinion of the author this problem is of exceptional therapeutic interest and merits further investigation. EDWARD W. GIBBS, M.D.

MISCELLANEOUS

Farris, Edward M., and Douglas, Russell V.: Abdominal Actinomycosis. *Arch. Surg.*, 1947, 54: 434.

A brief résumé of the clinical manifestations and therapy of abdominal actinomycosis is presented.

Five cases of abdominal actinomycosis treated at the Grady Hospital, Atlanta, Georgia, are reported. Apparent cures have resulted in all 5 cases.

The authors have used penicillin in all their cases in conjunction with sulfadiazine therapy. The value of chemotherapy in the treatment of abdominal actinomycosis is supported by the fact that after its prolonged use the numerous microscopic sections and repeated cultures of the surgically excised tissue showed no evidence of actinomycotic infection in 4 of the 5 cases reported here.

However, surgical treatment is of the utmost importance in the treatment of abdominal actinomycosis. Surgical drainage of all abscesses and excision of diseased tissue, insofar as can be achieved, are essential in the treatment of this disease.

CHARLES BARON, M.D.

Sweetser, T. H.: Surgery of Retroperitoneal Tumors. *J. Urol.*, Balt., 1947, 57: 651.

Three factors are especially important in the surgical approach to any malignant tumor: (1) it must allow exposure and division of the veins and lymphatics before any tumor cells can be squeezed into them by operative manipulation; (2) it must give the best possible exposure to reduce the risk by allowing better hemostasis and more accurate dissection; and (3) it must do the least possible damage to the surrounding structures. The latter is less important than the first two.

Most renal and other retroperitoneal tumors have been approached by either the lumbar extraperitoneal route, or by a transperitoneal route. The lumbar incisions described heretofore are unsound for removal of malignant tumors because they require manipulation of the tumor before the blood vessels and lymphatics are divided; moreover, these incisions give poor exposure unless important nerve trunks are divided. The transperitoneal incisions allow division of the renal pedicle before manipulation of the tumor, but are definitely more dangerous due to peritoneal exposure.

The author advocates an incision which has the advantages and relative safety of the lumbar route, and gives even better exposure than does the transperitoneal approach. The patient is placed on his side with the kidney rest up, and the usual oblique lumbar incision between the eleventh and twelfth dorsal nerve trunks is made. If the diagnosis of malignancy is confirmed, the incision is extended anteriorly across the rectus muscle to a point about halfway between the navel and the symphysis pubis, and is thence extended upward as a paramedian incision to the xiphoid. All layers of muscle and fascia down to the peritoneum are included. The large triangular flap is lifted laterally and upward over the retracted rib margin. With the use of the extraperitoneal layer of fat as a line of cleavage, the peritoneum is pushed aside unopened. After removal of the tumor, the wound is closed with interrupted sutures of No. 1 chromicized catgut, including all muscle and fascial layers en masse, placed before and tied after lowering the kidney rest and straightening the table. A continuous suture is placed in the external oblique fascia, and the skin is closed with clips. A Penrose drain is extended from the renal space posteriorly.

The author states that these wounds heal solidly per primum; most of his patients were out of the hospital on the thirteenth day. He states that surgery for any mass in the kidney should be undertaken with the possibility of malignancy in mind, and with adequate preparation and draping of the field. The incision described preserves the nerve supply to all the abdominal muscles, and the exposure is better than with any other kind of incision.

JOSEPH E. MAURER, M.D.

Babcock, W. Wayne: Newer Methods of Abdominal Drainage. *Arch. Surg.*, 1947, 54: 365.

The author briefly mentions the historical aspects of abdominal drainage. At one time surgeons, fearing to leave ligatures within the abdominal cavity, left the ends hanging from the wounds.

Investigations which began with local tissue reaction to waxed sutures and ligatures, inevitably led to studies of the reaction of foreign bodies to drains. The author and his surgical residents found that catgut sutures exposed on the peritoneal surface were soon covered by dense adhesions. Silk and cotton sutures formed adhesions but to a lesser degree, while stainless steel wire sutures formed no adhesions.

In applying these observations to abdominal drains, it was evident that in some cases it was desirable to produce early adhesions to localize the drained area, while in other cases adhesions prevented the drainage of outlying septic areas, and were harmful. Gauze drains were surrounded by adhesions in from one-half hour to 2 hours. Rubber tubes and plastic drains produced similar fibroplastic

reactions. However, glass tubing and stainless steel tubing left in the abdomen for 2 weeks produced no adhesions. Large open glass tubes (lamp chimney drains) anchored with stainless steel wire sutures over intestinal suture lines as a protection against leakage or necrosis of the bowel showed no adhesions at the end of 4 days.

The author discusses the methods and advantages of stage drainage of the abdomen, using fine stainless steel wire sutures and a large caliber glass or other tube. However, he believes that the most effective method of abdominal drainage, when there is intraperitoneal exudation, leakage, or contamination, is by means of a sump drain. The drain consists of a perforated tube made of glass or stainless steel, in which is placed a second aspirating tube which is connected by rubber tubing with a water spigot aspirator or an electric pump.

Sump drainage of the abdomen is used with great success by the author in cases of intraperitoneal leakage from a perforated appendix with diffuse purulent peritonitis, in most types of biliary surgery, in large bowel resections for carcinomas, and in cases of ulcerative colitis requiring major surgery.

The use of drains for preoperative and postoperative diagnosis, for the arrest of initial and recurrent hemorrhage, and for the early detection of ileus and other conditions is described. The use of jejunostomy in gastric surgery is discussed and various tubular enterostomy procedures are suggested as a substitute for a formal preoperative colostomy as a decompressive measure. Abdominal aspiration drainage by means of a sump drain, as shown by the author, is a surgical step forward and should find an ever widening field of usefulness. EDWARD F. LEWISON, M.D.

Sanders, G. B., and Hodge, I. G.: Surgical Management of Gunshot Wounds of the Pelvic Viscera and Their Late Complications. *Ann. Surg.*, 1947, 125: 399.

Because of the close association of viscera and organs of several systems within the pelvis, gunshot injuries of this region are among the most severe of war injuries. The pelvic fracture itself is relatively insignificant compared to the lethal potency of injury to its contents.

The primary surgical management of these injuries, guided by the principles of prompt recognition, early repair, efficient diversion of urinary and fecal currents, when necessary, and adequate drainage at all times, is of paramount importance, not only for the saving of life, but for the prevention of distressing complications later.

Deviation from fundamental surgical principles in early surgical care of gunshot injuries to the pelvis and its viscera results in increased mortality and morbidity, and in the necessity for further elaborate surgery involving the sacrifice of tissues and organs, with added risk to the patient.

Surgeons charged with the primary care of these injuries should be alert to the possibilities of concealed extraperitoneal damage to the bladder, rectosigmoid, and ureters. Injuries to the ureters are most often unrecognized at the time of primary operation when an unparalleled opportunity exists for the preservation of the associated kidney.

Proximal colostomies should divert and defunction, as well as decompress. Cecostomy is not an efficient diverting or defunctioning procedure.

The proper location of a proximal colostomy should take into consideration the likelihood of further reconstructive surgery upon the distal bowel. In wounds of the pelvic colon, especially, it may be wiser to place the colostomy no lower than the transverse colon, and to perform a complementary transverse colostomy along with exteriorization of a damaged pelvic colon.

Persistent fecal and urinary fecal fistulas, particularly those traversing bone, require a direct attack for permanent closure, which is most satisfactorily done transperitoneally upon a bowel defunctioned by an efficient proximal colostomy. Following efficient fecal diversion, spontaneous closure of urinary fecal communications often occurs, provided urinary decompression or drainage is maintained and infection of the urinary tract is kept at a minimum. Reopening of such an apparently closed urinary fecal communication commonly follows restoration of the fecal current, indicating that direct attack on the fistula is necessary for permanent cure, in most cases.

The histories of 5 illustrative cases are presented.

JOSEPH GASTER, M.D.

GYNECOLOGY

ADNEXAL AND PERIUTERINE CONDITIONS

Campbell, J. V., and Singman, D.: Primary Ovarian Malignancy. *West. J. Surg.*, 1947, 55: 263.

Sixty-eight cases of primary ovarian cancer showing definite histological evidence of malignancy are analyzed. Fifty-three of the tumors were cystic carcinomas, chiefly cystadenocarcinoma, 11 were solid carcinomas, and 5 were malignant functional tumors. In this series, the 5 year salvage was 8 per cent for cystic tumors, 30 per cent for solid tumors, and 100 per cent for functional tumors. The prognosis was worse if metastases, ascites, or bilateral tumors were present. The histological grading of these tumors was believed to be an aid in prognosis.

GEORGE BLINICK, M.D.

MISCELLANEOUS

Holmstrom, E. G., and McLennan, C. E.: Menorrhagia Associated with Irregular Shedding of the Endometrium. *Am. J. Obst.*, 1947, 53: 727.

The authors employ the phrase "irregular shedding of the endometrium" to indicate a specific type of functional uterine bleeding, a clinical and pathologic syndrome characterized by a typical pathologic picture, the outstanding feature of which is prolongation of shedding of the endometrium which has undergone progesterone stimulation. In addition, there is often an increase in the amount of bleeding. The diagnosis is suggested by the typical clinical history of regularly recurring menorrhagia, and may be substantiated by recovering the secretory endometrium by curettage during the course of prolonged bleeding, but well beyond the time when endometrial regeneration normally would have occurred.

The shedding of secretory tissue ordinarily is completed within from 48 to 72 hours after the onset of bleeding. Regeneration of a new surface occurs rapidly thereafter, and by the fourth or fifth day of the cycle one almost routinely observes new proliferative endometrium. One should not expect to find on the fifth day of menstruation comparatively large areas of secretory glands belonging to the previous cycle. This finding, coupled with a characteristic clinical history of menorrhagia, has been the authors' criterion for the diagnosis of irregular shedding of endometrium.

During a period of 3 years, uterine curettage was done on 242 patients in the Salt Lake County General Hospital, Salt Lake City, Utah. A pathologic diagnosis of irregular shedding of the endometrium was made in 22 of these. To demonstrate the nature of the problem, 3 cases are reported in detail and microscopic sections from 5 additional cases are shown. Typical microscopic findings are described in detail.

With regard to the etiology, a number of lesions in the uterus and endometrium may be concerned. The presence of submucous myomas or endometrial polyps may interfere with the normal shedding process; postabortal subinvolution of the endometrium may be associated; the simultaneous occurrence of adenomyosis and irregular shedding may be indicative of a common etiology. The authors find that there still remain a large number of cases in which the etiology is obscure, and their study is concerned particularly with this group of cases.

An attempt has been made to show a hormonal basis for the condition. The authors report the results of their experiments in 4 cases in which prolonged progesterone administration was carried out. Although the results have not been consistent enough to draw any conclusions, the investigation is being continued. It has been found that the microscopic picture characteristic of the disease can be produced in the endometrium of the normal female by the injection of progesterone during the bleeding phase of the cycle.

JOHN R. WOLFF, M.D.

Campbell, R. E.: The Treatment of Pelvic Tuberculosis in the Female by Radiation Therapy Based upon Experimental Evidence in the Animal and Clinical Results in the Human Being. *Am. J. Obst.*, 1947, 53: 405.

The treatment of pelvic tuberculosis in women has been subjected to considerable controversy. The author considers the radiologic aspects of therapy in this disease relative to experiments in the animal and clinical investigations in the human being.

It was decided to produce pelvic tuberculosis experimentally in the female dog and subject the animal to roentgen ray therapy in order to observe the effect. A strain of attenuated bovine tubercle bacilli, which tended to produce localized nonprogressive lesions, was selected as being suitable for this research. Twenty dogs in which the tuberculous process was limited to the pelvis were used and 9 of the dogs were studied over a 2 year period.

Analysis of the results showed that roentgen ray therapy was beneficial in pelvic tuberculosis, as there was a tendency to limit the disease to the pelvis, a direct effect upon the absorption of the exudate, and reduction of the secondary inflammation. These results led the author and his associates to believe that, contrary to the previous condemnation of the use of x-ray in the treatment of pelvic tuberculosis in the female, its use should be reconsidered. Selected case reports are presented.

JOHN R. WOLFF, M.D.

Lash, A. F.: Surgical Geriatric Gynecology. *Am. J. Obst.*, 1947, 53: 766.

The author reviews the results of previous studies of gynecologic surgery in the aged, analyzes a statistical study of a fairly large series of patients, and attempts to further evaluate the advantages, and the conditions under which gynecologic surgery may be

carried out in the aged. The established mortality rates for these age groups in relation to life expectancy are discussed.

The case records of 313 women, 60 to 87 years of age, were studied. These patients were on the gynecologic services of Cook County (196), Michael Reese (76), and Mt. Sinai Hospitals (41) in Chicago.

The mortality rate in old people treated surgically is higher than that in young people. Since the risk is greater in old people, each patient must be studied individually. The details of proper preoperative precautions, the selection of anesthesia (especially local), meticulous operative procedures, and of proper postoperative care are presented. The author concludes that gynecologic surgery may be performed in old women (past 60 years) under urgent, imperative, or elective conditions if these precautions are observed.

The higher mortality rate in older people (4.5 per cent in the series studied, and all occurring at Cook County Hospital) was due to sepsis, shock, embolism, pneumonic infections, uremia, cardiac failure, but also to the higher incidence of malignancies. With chemotherapy and blood transfusions, the most common operative complication may be combated. Hypertension without marked cardiac damage is no great hazard. It may be improved by overcoming the partial ureteral obstruction and its resultant effect on the kidneys, in the correction of pelvic hernia with the prolapsing uterus.

The author observes that the relief experienced by an old woman with procidentia with good life expectancy more than balances the risk involved in the surgical care. JOHN R. WOLFF, M.D.

Judd, G. E.: Preservation of the Upper Pelvic Floor and Bladder Support in Total Hysterectomy. *West. J. Surg.*, 1947, 55: 209.

In the author's method of hysterectomy the abdomen is entered by a lower midline incision. The uterus is separated from the round and broad ligaments or, if the adnexa are to be removed, from the infundibulopelvic ligaments. The bladder flap of the peritoneum is dissected from the anterior surface of the uterus and the cervix. The uterine arteries are ligated immediately outside of the lateral aspect of the uterus, preferably at a point above the origin of the main cervical branch of the artery.

The uteropubic fascia, which can be clearly identified, is dissected from the anterior surface of the cervix. Both sharp and blunt dissections are required, which should be continued downward to the anterior fornix of the vagina. By the described procedure the bladder and the ureters become easily movable; thus the danger of injury to these organs is greatly diminished. At the same time, as Richardson pointed out, a less vascular area will be encountered.

Subsequently, the cardinal ligaments are clamped by placing Kocher forceps inside of the uteropubic fascia, closely parallel to the cervix. By adjusting the clamps within the cuff of the uteropubic fascia, injury to the ureter can be prevented, as interference with this structure becomes virtually impossible.

The cardinal ligaments are severed from the cervix, down to the lateral fornices of the vagina. Upon separation of the cardinal ligaments from the cervix, it is advisable to preserve a small amount of cervical tissue to be used for suturing later on. The uterosacral ligaments are clamped and cut, and the intervening peritoneum is incised. The posterior part of the vagina becomes accessible and is entered through Douglas' pouch. The cervix is severed from the vagina under direct vision, with either knife or scissors. The cardinal ligaments are sutured to the lateral aspect of the vagina by figure 8 stitches. By placing the suture in the base of the cardinal ligament, lateral retraction can be prevented. In this manner the top of the vagina is incorporated into the supporting structures which previously served to sustain the cervix as well as the vagina. The top of the vagina is closed with interrupted or continuous sutures. In order to re-establish an adequate support for the vagina, the cardinal ligaments are approximated in the midline and sutured to the top of the closed vagina. Thus, after the cervix, which is the focal point of the endopelvic fascia, has been removed, the structures which had previously supported the cervix as well as the top of the vagina are again brought into contact and united. The sutures used in ligating the cardinal ligaments are then tied together for what little additional support they can give in uniting the cardinal ligaments.

The uteropubic fascia together with the mobilized bladder, which in the beginning of the operation had been dissected from the cervix, is now carried over the united cardinal ligaments and sutured to the uterosacral ligaments and to the posterior portion of the united cardinal ligaments, as well as to the rectovaginal septum or the postcervical endopelvic fascia. Thus, the main ligamentous structures of the upper pelvic floor, which preoperatively were connected through the cervix, laterally as well as anteroposteriorly, are now brought into immediate contact.

Finally, the entire operative area is covered with peritoneum by using the bladder flap.

DANIEL G. MORTON, M.D.

Reis, R. A., and DeCosta, E. J.: Stress Incontinence in the Female. *Am. J. Obst.*, 1947, 53: 776.

The authors' study is a consideration of the various factors concerned with the involuntary escape of urine through the intact urethra. Incontinence associated with obvious etiologic factors such as fistulas, nerve lesions, and congenital anomalies are not considered.

Complete incontinence is rarely encountered, but partial incontinence brought on by sneezing, coughing, or straining is all too common. It is to this type of incontinence that the word "stress" is applied.

The authors describe the anatomy of the female bladder, urethra, and associated structures, and discuss the physiology of micturition. The etiology of incontinence is presented, the authors finding obstetric injury to the urethra and supporting structures the commonest cause of stress incontinence.

Operations devised to correct stress incontinence are evaluated. All these procedures have in common the tightening of the fascial planes which surround the urethra, together with reduction of the urethral lumen.

The paraurethral operation described by Berkow is presented in detail. The procedure involves an encircling incision around the external urinary meatus with subsequent paraurethral dissection toward the bladder until the urethra has been freed sufficiently to allow the dissected urinary meatus to lie just under the clitoris without tension. The urethra is now anchored just below the clitoris by three interrupted mattress sutures, using chromic catgut No. 00. This upward placement of the urethra brings into view the pubococcygeus muscles which are now united in the midline beneath the urethra by two to four interrupted sutures. The bulbocavernosus muscles are then united in the midline, thus completing the second layer of sutured muscles which hold the urethra upward.

The authors present a series of 33 patients suffering from stress incontinence, in whom the procedure was carried out. It was completely successful in 31 patients, the 2 failures occurring in women in whom the etiology of the stress incontinence was not obstetric. Patients were followed for periods ranging from 5 to 54 months postoperatively.

In conclusion the authors state that paraurethral fixation is a most satisfactory operation for the relief of stress incontinence following obstetric injury.

JOHN R. WOLFF, M.D.

OBSTETRICS

PREGNANCY AND ITS COMPLICATIONS

Fumarola, A.: Survey of 436 Cases of Ectopic Pregnancy (Considerazioni clinico-statistiche sopra 436 casi di gravidanza ectopica). *Ginecologia*, Tor., 1947, 13: 49.

The present series of 436 cases of ectopic pregnancy was gathered from the Clinica Ostetrica e Ginecologica of the University of Rome over a period of 8 years. All of the cases were carefully studied as to their past and family history, symptomatology, pathology, and clinical course. Although age, social condition, the time elapsing since the beginning of sexual life, and parity of the husband and wife appeared to be predisposing factors to the ectopic condition, a constitutional factor and the presence of inflammatory changes were found to be the principal causes. The former was commonly manifested by irregularity of the menarche or subsequent menses, or a defective previous pregnancy. To these two causes were added minor ones, such as previous gynecological intervention, the presence of structural changes (cysts or fibromas), acute or chronic enteritis, appendicitis, or peritonitis.

Review of these 436 cases indicated that prophylaxis of the causes presented could well be instituted.

EDITH B. FARNSWORTH, M.D.

Rivière, M., Saric, R., and Navarranne, P.: Albuminurias of Gestation. New Physiopathological and Pathogenic Concepts (Les albuminuries de la gestation nouvelles conceptions physiopathologiques et pathogéniques). *Gyn. obst.*, Par., 1946, 45: 438.

Under the term "albuminurias of pregnancy" are included those which occur essentially because of the state of pregnancy and not from any coexistant condition such as nephritis. What the authors refer to as "monosymptomatic albuminuria" lasts throughout pregnancy, regresses thereafter, and is often associated with symptoms of pre-eclamptic toxemia. The association of eclampsia and uteroplacental apoplexy and albuminuria is analyzed.

Monosymptomatic albuminuria occurs in from 30 to 80 per cent of all pregnancies according to various authorities. It appears most often in primiparas. It is detected most often in the last trimester of gestation. The amount of albumin in the urine varies from a trace to several grams. There is no oliguria with this type of albuminuria, the physical properties of the urine are not modified, and sediment is minimal. Infectious causes for the albuminuria have been ruled out. There may be no clinical manifestations coexistant with the albuminuria. The evolution of this type of albuminuria is variable; even without treatment it tends to stabilize itself without accident to mother or fetus. Generally it tends to increase gradually during pregnancy and disappear after parturition; it appears in subsequent pregnancies.

In the study of pre-eclamptic toxemia, albuminuria generally represents the initial symptom, followed by hypertension, edema, oliguria, gastric upsets, headache, and visual disturbances. While, under treatment, the subjective symptoms of pre-eclampsia disappear, albuminuria persists. Death of the fetus modifies the pre-eclamptic state in many ways but it does not modify the albuminuria.

Clinical eclampsia is always preceded by the pre-eclamptic state of which albuminuria is the earliest symptom. A survey of all the concepts and observations leads to the conclusion that eclampsia is a renal syndrome, which may be referred to as uteroplacental apoplexy. The authors seek to determine whether the various symptoms of eclampsia can be dissociated from one another, or whether they are simply all manifestations of a single etiology.

Does monosymptomatic albuminuria represent a pathological or clinical entity? It does not attest to kidney disease any more than does orthostatic albuminuria. It appears to be solely a functional trouble. The rarity of cylindruria, persistence of normal diuresis, normal renal permeability, and reversibility of signs after gestation argue for a purely functional derangement.

The role of the nervous system, particularly the sympathetic system, in renal pathology has long been known, proved clinically and by animal experimentation. Even in functional conditions the role of the nervous system is significant. The character of the albuminuria, its evolution, and its habitual reversibility, all plead in favor of an initial functional glomerular cause identical with that of experimental albuminurias; in the latter cases there is no pre-existing nephritis. This concept of gravid albuminuria substitutes the notion of a functional renal trouble of nervous origin for the notion of a renal parenchymal cause. It is by the sympathetic route that the excitation attains its receptive organ. Cannot one admit then that gravid albuminuria is a functional derangement of the sympathetic nervous system?

The various symptoms of eclampsia are examined in the light of this concept. The oliguria observed is of short duration and appears to be due more to a reflex mechanism than the anurias observed in cases of toxic or infectious nephritis. As to edema (absent by definition in monosymptomatic albuminuria), it exists independently of all renal manifestations and appears suddenly; its location in the body is often unusual and is not in keeping with the concept of chloride retention secondary to impaired renal permeability—which points to a functional overactivity of the posterior lobe of the pituitary gland. The role of the nervous system in hypertension has been proved by the Goldblatt experiments. Azotemia has been observed in animals on prolonged sympathetic excitation, and clinically in cases of cerebral hemorrhage, both observations attesting to a functional

origin. Retinopathy and neuropathy are two peripheral manifestations of angiospasm, a functional state. Convulsive seizures, which may or may not be preceded by albuminuria and hypertension, originate from a diencephalic center. In fact all of the symptoms of eclampsia seem to have their origin in the region of the hypothalamus.

The albuminuria of gestation and all its related symptoms seen in eclampsia can be ascribed to a functional derangement of the diencephalic and pituitary sympathetic centers, which are anatomically and functionally a unit. Gestation seems to set off the hypophysial infundibular mechanisms which appear in regular chronological order.

Estrogenic studies of diabetic pregnant women reveal that in all cases in which toxemia was present there was an abnormal level of estrogens and an elevation of gonadotropin, this elevation preceding by several weeks the appearance of the pathological phenomena.

Gestation is not the only condition which gives rise to modified hormonal levels in the maternal organism. There is no hormone specific to pregnancy, and many changes that occur in pregnancy have their counterpart in the normal menstrual cycle.

It is not unreasonable to think that the albuminuria of pregnancy is no more than a peripheral manifestation of a general process of which the physiopathological mechanisms have their origin in the diencephalon and their course through the sympathetic nervous system, under endocrine regulation.

PHILIP B. CHASE, M.D.

Ellis, J. T., Windham, S. W., Jr., McFatter, T. K., and Latiolais, S. G.: Spontaneous Rupture of the Uterus. *South. Surgeon*, 1947, 13: 270.

The authors report, in detail, 2 cases of spontaneous rupture of the pregnant uterus. One patient was a primigravida of 4½ months' gestation, the other a 37 year old multigravida at term. In the case of the primigravida, the condition is believed to be unusual in that sepsis following rupture of the uterus had resulted in a fistula of the abdominal wall through which a fetal hand was protruding. The multigravida was delivered of a living child by cesarean section though the fetus had been extruded completely into the peritoneum.

In America, rupture of the uterus occurs less frequently than in Europe because there is less pelvic distortion due to rickets and osteomalacia, and more medical supervision in obstetrics. The incidence of this condition, as reported in large obstetrical centers, ranges from 1 in 95 to 1 in 4,000 deliveries; it occurs only rarely before the onset of labor. Baisch, in 1903, collected 78 such cases from the literature. Since that time the list has grown very gradually, but the condition is still rare. The etiological factors include previous cesarean section, especially of the classical type, previous myomectomies, improper and energetic curettements, and previous pelvic infection. This last factor is considered one of the important predisposing causes to uterine rupture. Microscopic study of these uteri show increased fibrous tissue in the uterine wall.

Rupture of the uterus before the onset of labor usually occurs in the fundus, whereas ruptures occurring during labor are more often in the lower uterine segment.

Practically all cases of spontaneous rupture of the uterus are in multiparas with an average of 4 to 6 siblings in the various groups reported.

The signs and symptoms in the order of frequency are bleeding, severe pain, abdominal tenderness, cessation of labor, shock, pallor, change in position of the fetus, syncope, blood in the urine, and distention. Two of these symptoms are emphasized: cessation of labor, and blood in the urine. These symptoms plus abdominal tenderness should always be treated as rupture of the uterus.

The treatment of choice is laparotomy. Only by this means can a normal infant be delivered and the hemorrhage stopped, and the uterus repaired or removed. Shock must be treated with sufficient blood or plasma. Infection must be combated by drainage, sulfadiazine, and penicillin.

The maternal mortality varies in the series reported from 50 to 100 per cent. The fetal mortality is about 90 per cent. In the authors' cases, both mothers died; however, one of the infants lived.

HARRY FIELDS, M.D.

Russell, P. B., Jr.: Abortions Treated Conservatively; a 12 Year Study Covering 3,739 Cases. *South M. J.*, 1947, 40: 314.

The author's cases of abortion are divided into three groups based upon the years in which they occurred. Further classification was based upon the clinical picture and was as follows:

1. Spontaneous, with onset from no apparent cause.

2. Criminal, with a history of an aborted patient or instrumentation.

3. Complete, with a history of pregnancy and the passage of products of conception. Little or no uterine activity.

4. Incomplete, with a definite history of pregnancy and the passage of some part of the products of conception.

5. Febrile, with a temperature of 100.4° F. or more on 2 or more days after the first 24 hours, and with or without active signs of infection. (These patients should be isolated.) About one-fourth of the total will be in this group.

6. Afebrile, with no fever or active signs of infection on admission or during the convalescent period. About 75 per cent of the cases were in this group.

7. Septic, with a history of abortion and the lapse of some time before admission of the patient to the hospital.

A vaginal examination should be limited to the introduction of the speculum for smears. In general, the treatment is as outlined below:

1. The vulva should be prepared with sterile soap and shaved. A perineal douche of 1 to 1000 mercuric

cyanide solution is given. The vaginal speculum is introduced under aseptic conditions and material protruding from the vagina is removed, but exploration is not done further than the internal cervical os. Five cubic centimeters of extract from the posterior pituitary lobe are given intramuscularly upon admission if the abortion is complete or incomplete. In threatened cases this is omitted.

2. In febrile or suspected criminal cases cervical smears and material for culture of aerobic and anaerobic organisms are taken from the uterine cervical canal. The material should be secured less than ½ inch internally of the external cervical os.

3. Plasma should be given on admission if needed. Daily transfusions may be given to combat infections. The Rh factor of the blood for transfusion should be considered.

4. The entire head of the bed should be elevated about ½ foot for postural drainage and the patient should be turned on her abdomen for an hour twice daily.

5. In any case with abnormal bleeding (complete or incomplete abortion), from 0.5 to 1 c.c. of pitocin, ergotrate, or obstetrical pituitary extract solution should be given every hour in the deltoid muscle for 3 doses and followed by a 1-320 gr. tablet of ergotrate per mouth every 4 hours for 6 doses. The same treatment should be given for endometritis.

6. Persistent hemorrhage may necessitate the use of a sponge stick as a curette or for packing only.

The author concludes that on the basis of his results the approach to the management of various types of abortion should be conservative. He points out that conservative treatment was unsuccessful in only 35 of the 2,406 cases of incomplete abortion.

JAMES F. DONNELLY, M.D.

LABOR AND ITS COMPLICATIONS

Trolle, D.: Induction of Labor by Means of Partergin, an Ergot Alkaloid. *Acta obst. gyn. scand.*, 1947, 27: 94.

Partergin, a new ergot alkaloid, is a watery solution of methyl-ergobasine-tartrate (1 c.c. of solution is equivalent to 0.075 mgm. of methergine). Previous reports have stated it to be free of the complications occurring after the administration of pure ergobasine.

To evaluate objectively the effect of partergin, labor was induced in 48 normal patients by 67 attempts at induction with this drug. The results have been compared with those obtained from 128 attempts at induction on 62 normal patients with pitupartin, a pituitary preparation, 1 c.c. of which equals 10 Vöghtlin units. Fifty patients with normal spontaneous labors were used as controls.

When the fetus weighed 3,300 gm. or more, partergin was superior to pitupartin for the induction of labor. If the fetal weight was less than 3,300 gm., the difference was not significant. The percentage of successful inductions with partergin was higher when the birth weight was 3,300 gm. or more (79.7%), than when it was less than this weight (43.0%). No significant difference was demonstrated in the induction of labor between primiparas and multiparas. The medical induction of labor did not seem to increase the frequency of premature rupture of the membranes, nor influence the duration of the parturition. No increase was noted in postpartum hemorrhage. There were no harmful effects upon the mothers.

Following the administration of partergin, a significant increase in the tension of the uterus was noted 10 times. In 3 of the 48 cases, fetal death occurred.

The authors advise against the use of partergin for the induction of labor if the fetus is alive.

GEORGE BLINICK, M.D.

Vikbladh, I.: Case of Ovarian Cyst Ruptured in Connection with Delivery. *Acta. obst. gyn. scand.*, 1947, 27: 11.

The author reports a case of an unrecognized intrapartum rupture of a large ovarian cyst in a primigravida of 19 years, who, on the day following rupture, was delivered normally of a fully developed living male child. On the fourteenth postpartum day, a laparotomy was performed for the presence of an ovarian cyst with ascites. There were found 2 to 3 liters of free, clear, gelatinous fluid in the peritoneal cavity and a left multilocular pseudomucinous cystoma, 28 by 20 by 16 cm., with a perforation in the cyst wall. The cyst was extirpated and the postoperative course was uneventful. References to the rupture of ovarian cysts during pregnancy are briefly reviewed.

GEORGE BLINICK, M.D.

PUERPERIUM AND ITS COMPLICATIONS

Bubis, J. L.: Puerperal Gynecology. *Am. J. Obst.*, 1947, 53: 787.

The author reports a personal experience extending over a period of 30 years in the performance of repair operations for old, new, or combined birth injuries immediately after delivery. In addition, he presents statistical reports of puerperal gynecology as practiced in the obstetric department of Mt. Sinai Hospital, Cleveland, Ohio, from 1936 to 1946. The author states that time has not changed, but rather has strengthened, his conviction that puerperal gynecology is feasible, safe, and of immeasurable value to the patient and should be universally adopted as an integral part of natal care.

The importance of repair of cervical lacerations is stressed, and the salient features of the surgical technique are reviewed. Repair of cystocele, rectocele, lacerations of the vaginal walls, and the management of hemorrhoids are discussed.

The experience of the author and his colleagues with thousands of operations performed immediately after delivery in a series of over 20,000 obstetric cases is presented to refute all possible objections to these procedures. Although such operations require special training, skill, and care, they have proved successful in the hands of many different surgeons.

Advantages to the mother include improved general health, saving of time and money, prophylaxis against subsequent disabilities, and probable protection from cancer in later life.

JOHN R. WOLFF, M.D.

Hodgkinson, C. P.: Penicillin and Acute Puerperal Mastitis. *Am. J. Obst.*, 1947, 53: 834.

The author reports his experience in the treatment of 73 cases of infected breasts observed since 1942, all but 7 of which developed in the postpartum period.

In the group with peurperal mastitis, 18 patients, when first seen, were suffering from abscess. Sixteen of the breasts required incision and drainage, while 2 cleared after aspiration. Forty-eight patients were treated with intramuscular penicillin during the cellulitis phase of the disease, with complete resolution in each instance. This response was reflected by the evident decrease in morbidity which averaged 6.1 hospital days. In contrast, the surgically treated group required 42.2 days from onset to complete healing.

Because penicillin is not secreted in the milk in sufficient amounts to control contaminating staphylococci, it is believed advisable to inhibit lactation to prevent reinfection of the breast.

Sulfonamide therapy is not recommended as a substitute for early penicillin therapy. Before penicillin became available, 12 patients were treated during the cellulitis phase of the disease with various sulfonamides in apparently adequate dosage; 9 patients required incision and drainage of an abscess, giving a failure of 75 per cent; and 4 patients were admitted for penicillin treatment after having failed to respond to sulfadiazine. All promptly resolved when penicillin was given.

JOHN R. WOLFF, M.D.

MISCELLANEOUS

Morris, W. I. C.: Outlet Contraction of the Pelvis. *Edinburgh M. J.*, 1947, 54: 90.

The author states that there is no great unanimity with regard to the incidence or even the existence of outlet contraction of the pelvis. The incidence varies, with the author quoted, from 6 to 26 per cent, and there are those who minimize its importance. In the present article, diagnostic criteria which might prove helpful in outlet contraction are examined.

Normally, as the fetal head meets outlet resistance, it is molded in full flexion so that it approximates a cylinder with biparietal, suboccipitobregmatic, and occipitofrontal diameters, all about equal, averaging 9.3 cm., or the largest diameter if the head remains in flexion. During extension, an oblique measurement must pass the outlet; roughly, this is 10 cm.

The axis of advance of the fetal head through the pelvis makes almost a right angle bend to get to the outlet.

Bony contraction of the outlet may result from (a) absolute narrowing at the plane of least pelvic dimensions, (b) narrowing below the level of this plane or narrowing of the pubic arch, and (c) combinations of "a" and "b." The first of these may involve either the coronal or sagittal measurements of the outlet. The narrowing may be a general funneling of the entire pelvis, frequently associated with android pelvis, high assimilation pelvis, and some spinal deformities, or an isolated narrowing frequently seen with prominent ischial spines or unusual convergence of the lower sacrum towards the symphysis pubis. Narrowing of the pubic arch is usually independent of any other alteration of the pelvis and results in reduction in available anteroposterior space for the advancing head, and may result in interference with internal rotation and increased perineal trauma.

The author mentions the various ways of measuring the pelvic outlet, points out their inadequacies, and suggests an engineering principle, namely, the use of a gauge in assessing the caliber of an irregular aperture, or a gauge with a diameter of 9.3 cm. In fitting this gauge into the dried pelvis two points are made: (1) the distance between the pubic arch and the cylinder should not exceed 1 cm., and (2) the coronal diameter of the cylinder should be at least 1 cm. in front of the ischial tuberosities.

In measuring the living subject, the author describes x-ray pelvimetry, and the technique which he employed. In addition, a transparency on which is outlined a circle of 9.3 cm. diameter is superimposed on the x-ray film. The lateral film permits one to make allowances for a narrowed pubic arch angle by correcting the anterior and posterior diameter to what the author calls the "corrected anteroposterior diameter of the outlet."

Cases are illustrated, with diagrams of some of the abnormal findings.

Clinically, the following measurements are taken: (a) the anteroposterior of the least pelvic plane, (b) the intertuberischial, (c) the posterior sagittal, and (d) the anterior sagittal. Attempts are also made to form subjective impressions of (a) the amplitude of the pubic arch and (b) the distance between the ischial spines. The author believes the only measurement that can be taken accurately is the anteroposterior diameter of the least pelvic plane. The other vaginal measurements are described and their inaccuracies discussed.

By taking the anteroposterior diameter of the plane of least pelvic dimensions one can at least pick out the cases for complete x-ray pelvimetry.

He states that with x-ray pelvimetry, the diagnosis of a contracted outlet may be made with complete confidence if the anteroposterior or transverse diameter of the plane of least pelvic measurement is less than 9.3 centimeters, admitting that slight narrowing in one direction may be compensated for if the other diameter is larger, and assuming that some molding is possible. He suggests that the measurement which he has referred to as the "corrected anteroposterior diameter of the outlet" can be taken as an index of outlet contraction, but states the critical figure is

larger than 9.3 cm. because, although the head may pass the plane of least pelvic dimensions well flexed, the classical mechanism of extension is likely to enlarge the diameter so that 10 cm. should be the figure chosen in determining outlet contraction.

The author also believes that an anteroposterior measurement of 11.5 cm., while not absolutely ruling out contraction of the least pelvic plane, does indicate that severe contraction is unlikely.

He cautions that the 9.3 centimeter diameter is an average and represents molding in flexion, and that other conditions, particularly breech presentation, alter these diameters markedly. The soft tissue has been deliberately neglected to emphasize bony abnormalities.

Outlet contraction may show itself in various ways, chiefly in the second stage of labor, but also in the first and third stages. In the first stage uterine inertia may develop with hour-glass contraction of the uterus.

Injuries to soft tissue may result from outlet contraction and also from springing of the symphysis pubis.

The treatment consists of antenatal planning in which one must decide to (a) allow labor at term, (b) induce labor prematurely, and (c) carry out elective cesarean section.

Labor should be carried out with conservatism, with analgesia during the first and second stages of labor. The author seems to favor postural treatment when the head is visible or easily palpable through the perineum, namely, the exaggerated lithotomy position. If this fails, he favors the application of forceps, especially in primigravida after deep episiotomy. Strict cephalic application should be made and the forceps used mainly for traction, and not rotation. BYFORD F. HESKETT, M.D.

Caso, Rogelio; Uranga Imaz, Francisco, A.; and Rozas, Francisco Fernández: Pelvic Separation (Disyuncion pelviana). *Bol. Soc. obst. gin. B. Air.*, 1946, 25: 540.

There are four grades of pelvic separation: (1) complete separation of the cartilage without serious injury to the ligaments and hence without great separation of the margins; (2) injury to the ligament great enough to permit considerable separation of the torn margins and an accompanying sacroiliac lesion; (3) rupture complicated with injury to the skin, vagina, or bordering structures; and (4) complete rupture of the symphysis pubis. The last is the extreme form.

X-ray has increased recognition of the entity and facilitates the diagnosis.

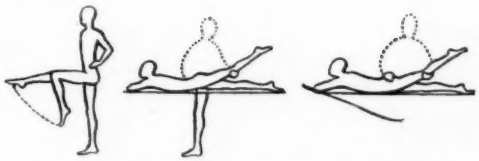


Fig. 1. (Caso *et al.*) Maneuvers used for diagnosis.

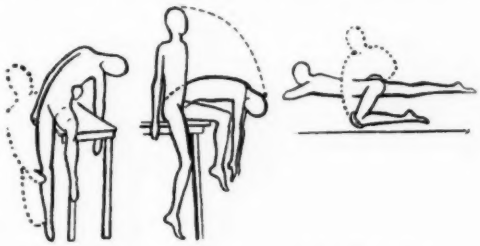


Fig. 2. Additional maneuvers used for diagnosis.

Prolonged labor or operation is the usual cause of the lesion.

Contributory factors are: (1) local relaxation of the symphysis or tearing of the cartilage; (2) size of the fetus; (3) prolonged labor, the mechanism of labor (the passage of the fetal head through the pelvic ring), or intense abdominal contractions; (4) application of the forceps; (5) simple dystocia because of stretching of the pelvic ring; (6) trauma; (7) age of the patient; (8) multiparity, and (9) medical mismanagement.

The diagnosis of sacroiliac complication is facilitated by maneuvers shown in Figures 1 and 2. Pain is aggravated by each movement.

Complications include hemorrhage, injury to the urinary mechanism, complete rupture to the exterior, associated fracture, and infection.

Treatment consists in prophylaxis if a diastasis exists or is likely to occur, and proper measures should be taken even during the course of the labor. Immediate therapy consists of (1) immobilization in bed between sand bags; (2) pelvic bandaging and use of the hammock; (3) corseting and bandaging; and (4) bandaging with continuous weighted extension.

Suturing of the symphysis has been abandoned as definitive treatment. Dubrovsky has advocated a body cast with a turn screw which permits tightening as indicated. STEPHEN A. ZIEMAN, M.D.

GENITOURINARY SURGERY

ADRENAL, KIDNEY, AND URETER

MacDonald, S. A., and Matthews, W. H.: Fibrin Foam and Gelfoam in Kidney Wounds. *J. Urol.*, Balt., 1947, 57: 802.

Two hemostatic agents, (1) fibrin foam, a by-product of fractionation of human blood plasma, and (2) gelfoam, a synthetic made from gelatin solution, were investigated for the purpose of comparing their local effect on tissues following implantation in the kidney.

For this study, large nephrotomy wounds were made in a dog's kidney, completely encircling either pole and extending almost to the renal pedicle. In all experiments, gelfoam or fibrin foam was laid in the wound, which was then closed by mattress sutures in the capsule only. The kidneys were removed at six-day intervals, the longest observation period being 24 days in the case of fibrin foam, and 36 days with gelfoam. In no instance was there any evidence of postoperative bleeding. The excised kidneys were examined grossly and microscopically with the following findings:

All showed uninterrupted healing with no discernible difference in the rate or character of healing. Microscopically, there was no marked inflammatory or foreign-body reaction in the wounds.

The absorption process of the two substances seems to be entirely different. Fibrin foam disappears quite rapidly and undergoes rapid liquefaction. The wound defect fills with granulation tissue, with considerable inflammatory cell exudate; then the usual process of cellular proliferation and fibrosis occurs. The gelfoam wounds show many strands of the substance acting as a scaffolding on which granulation tissue and fibroblastic cells are laid down. Associated with the fibroblasts are many multinucleated giant cells. This gelfoam framework gradually disappears and is replaced by collagen deposits in which the process of healing is completed.

In every instance, fibrin foam was almost completely absorbed in 12 days, and totally absorbed in 18 days. Gelfoam absorbed slowly, requiring 24 days for any noticeable diminution, and some gelfoam was found in the 30 and 36-day specimens. Despite the slow rate of autolysis, the gelfoam substance does not produce any corresponding increase in fibrosis or foreign-body reaction.

A detailed report on specimens of each substance is given. ROBERT O. BEADLES, M.D.

Robinson, R. H. O. B.: Some Problems of Renal Lithiasis. *Proc. R. Soc. M.*, Lond., 1947, 40: 201.

This very thorough study deals with some particular problems bearing on the etiology, diagnosis, and treatment of stone in the upper urinary tract.

A distinction is drawn between fixed and mobile renal calculus, the latter term referring to a stone which can migrate within the pelvis and calyces, usually being of such size as to be capable of temporarily obstructing the ureter and thereby predisposing to dilatation and stasis behind it.

Calcification (type I and type II of Randall) is also mentioned. In the latter an intratubular calcification results from excessive excretion of calcium phosphate, and actual deposition occurs in the walls of the tubules as a result of degenerative changes in them associated with defective blood supply or toxic irritants. In the former an interstitial papillary calcium plaque develops, probably as a result of a response of the kidney to toxins.

Stones develop at a rapid rate in patients who are immobilized in the supine position and are due to stasis alone. The tendency to precipitation is increased when calcium metabolism is upset, partly by disuse atrophy of bone, and by bone disease or bone trauma. These calculi are composed primarily of calcium phosphate, soft and coralline in structure, and are situated in the most dependent calyces. They tend to disperse rapidly if the kidney can be flushed by getting the patient out of bed. Frequent x-rays are advisable in recumbent cases. The normally acid urine becomes rapidly alkaline on immobilization. Hence, an acid ash diet and ammonium salts should be given. Mineral oil aperients are undesirable because they lead to deficient absorption of Vitamin A.

The close relationship between infection and stone is also mentioned, attention being drawn to the fact that the organisms in the kidney urine may change from time to time.

Prolonged exposure to heat and sun in hot climates has a definite influence upon the incidence of renal calculus. White races appear to have a higher susceptibility than black.

Calculi associated with hyperparathyroidism are a well recognized group at the present time, but a point which is not so well appreciated is that they can occur without any lesions of the bony skeleton. There is a close relationship between vitamin D deficiency and hyperparathyroidism, vitamin D aiding in the absorption of calcium from the intestinal tract while the parathyroids mobilize it from osseous tissue.

Deficiency of vitamin A disturbs the calcium-phosphate ratio and produces changes in the epithelium of the urinary tract.

Oxamide and sulfonamide calculi are obvious instances of crystallization due to the hyperexcretory state in which the colloid can no longer hold the excess crystalloid in solution. Oxalates produce secondary deposition on pre-existing calcium plaques, especially if hyperoxalemia and hyperoxaluria are present. Oxaluria may be due to a disturbed calcium-phosphorus ratio or to an incomplete oxidation of carbohydrates. Calcium-phosphorus metabolism

is probably the most important factor in stone formation. The calcium level is influenced by parathormone, vitamin D, serum protein, and the serum phosphorus, with which last it varies inversely. Hypercalciuria is present in hyperparathyroidism, hypervitaminosis D, uremia, and many diseases of bone, the principal endogenous source of calcium; 70 to 90 per cent of calcium is excreted in the feces and 10 to 30 per cent in the urine; 30 per cent of phosphorus is excreted in the feces and 70 per cent in the urine. Vitamin D and the acid ash diet increase calcium elimination. An excessive chloride acidosis increases the urinary excretion of calcium and is most marked in the case of ammonium chloride. The metabolism of citric acid has a definite relationship to the formation of renal calculi. Citric acid is present in large quantities in bone, where it is interrelated with calcium. The amount of urinary citric acid increases in an alkaline, and decreases in an acid urine. The presence of the citrate-ion influences the ionization of calcium, tending to replace the calcium-ion participating in the precipitation of calcium phosphate by the readily ionized, soluble calcium citrate complex. It has been shown in many cases of recurrent renal calculi without infection that subnormal amounts of citric acid and excessive amounts of calcium are present in the urine. Estrogens increase urinary citric acid without affecting the hydrogenion concentration and they also lower the output of calcium.

The administration of aluminum hydroxide gel forms the highly insoluble aluminum phosphate in the gut and much reduces the absorption of phosphorus. This prevents the precipitation of calcium phosphate in the urine.

Acidifying agents lower the urinary excretion of citrate and increase that of calcium, thus keeping the urine saturated and only capable of dissolving the endogenous calcium phosphate without being able to dissolve any existing calcium phosphate deposits; in other words, to inhibit further stone growth but not to remove stones already present.

The indications for surgical intervention are obstruction of the drainage mechanism of the kidney, as evidenced by dilatation shown on intravenous urography, especially if there is no likelihood of the stone being passed naturally. Any evidence of failing function in the obstructed part and especially any suggestion of the onset of infection demands active intervention.

Nonoperative treatment is indicated under the following conditions: (1) limitation of the calculi to the cortical part of the kidney where they have no macroscopic connection with a calyx; (2) mobile stones causing no obstruction, and of such size as to make passage per vias naturales possible; (3) stones composed of calcium phosphate or mixed phosphatic stones; (4) bilateral stones associated with gross disease and limited function in both kidneys, rendering any operation hazardous.

Much can be done by forced fluids, by correction of faulty diet, and by attempts to control superadded infection. In the case of decubitus calculi or stones consisting wholly or largely of phosphates, attempts may be made to dissolve the calculi by the use of Suby's solution G; and it is most important to bring this about before secondary infection supervenes, particularly with urea-splitting organisms, which render the stones relatively insoluble. Sometimes dissolution will proceed satisfactorily and then be arrested, owing to the stone having a part composed of some insoluble salt such as oxalate; nevertheless, it may have brought about such a reduction in size as to render the natural passage of the stone possible. Another cause of possible difficulty is a slowing down or cessation of dissolution in solution G due to the deposition of a mucoid gelatinous covering on the surface of the stone. If a 0.5 per cent solution of urease be substituted for a few hours, this envelope is dissolved, and solution G may again prove effective.

For surgical exposure, the author favors an incision in the line of the twelfth rib with subperiosteal resection of the rib at the posterior end of the incision. Calculi should be removed by pyelolithotomy if possible. Nephrolithotomy has always seemed to be an undesirable operation to the author because of the nightmare of secondary hemorrhage, which may necessitate a secondary nephrectomy, especially where the kidney is grossly infected. He also favors a nephrostomy tube in cases in which dilatation has resulted from the presence of a stone. The presence of the tube renders lavage of the pelvis much easier if it becomes necessary.

Calicectomy or partial nephrectomy is a very useful procedure in preventing stone recurrence, particularly when a ragged cavity remains in the lower pole of the kidney after the removal of a stone. Postoperative hemorrhage is less likely from the resulting cleanly incised and accurately approximated area of renal tissue, than from an incision into a ragged, infected cavity surrounding a calculus.

In the presence of bilateral stone, considerable judgment is required in deciding whether to operate at all or which side to approach first. Nephrectomy or even nephroureterectomy may prove the wisest course, as the infected calculus kidney seldom if ever returns to complete normality. When, however, the disease is bilateral, conservative surgery, even if it leaves a second rate kidney in the end, may be the only possibility.

Ureteric calculi The indications for active surgical intervention in the case of ureteric calculus are the same as in the case of renal calculus, that is, dilatation of the upper urinary tract above the stone, particularly if infection is superadded. If neither dilatation nor infection is present, a conservative attitude can be adopted indefinitely. The rapid rate at which an obstructed kidney may become totally destroyed once infection gains a foothold must, however, be kept in mind.

A smooth ureteric stone may retreat into the renal pelvis, thereby relieving obstruction of the kidney. Retreat of a ureteric calculus may sometimes be brought about by preliminary investigations, and

this fact emphasizes the importance of x-ray control immediately before or, preferably, if necessary, during operation.

In the case of the pelvic portion of the ureter, spontaneous passage of calculi occurs in a high proportion of cases (90 per cent in the author's) although some time may be taken in the process.

Of the instrumental methods, the author has found the use of an indwelling ureteric catheter (passed alongside the stone and kept *in situ* for 48 hours) the most satisfactory method. If the Howard corkscrew or the Councill umbrella extractor is used, it is always wise to insert an indwelling ureteric catheter to counteract the effects of reactionary edema. The author is very apprehensive of their use, despite the results that have been achieved.

Actual meatotomy of the ureteric orifice is seldom necessary and is better avoided because of the risks of troublesome hemorrhage and, more important, ureteric incompetence with vesicorenal reflux.

If instrumentation fails operation is indicated. The author employs both the midline and inguinal approaches. The latter is simpler, but if the stone is very low he prefers the former. Under certain conditions a transperitoneal approach may have great advantages, particularly in women.

FREDERICK A. LLOYD, M.D.

BLADDER, URETHRA, AND PENIS

Mentha, C.: Roentgenographic Examination of the Bladder; Stereopneumoiodocystography (L'examen radiologique de la vessie (stéréo-pneumo-iodocystographie). *J. urol. méd.*, Par., 1946–1947, 53: 89.

The author describes a new method to visualize X-ray transparent objects in the bladder, such as soft calculi, diverticula, and tumors of the bladder or of the prostate. He uses as contrast medium a mixture of air and an iodine containing compound.

After emptying the bladder completely with a catheter, 20 c.c. of the contrast medium Roche and

Fig. 1 (Mentha). Bladder deformed by the catheter. Diverticula on the right side, one of which has a long pedicle. Intravesical projection of a prostatic adenoma which extends to the left lateral wall of the bladder.

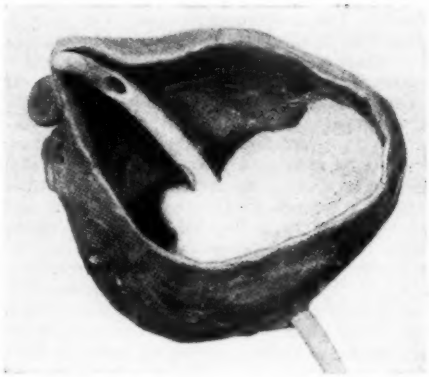


Fig. 2 (Mentha). Interpretation of the stereoscopic view of Fig. 1.

100 c.c. of air are injected through the same catheter which remains in place and is clamped off.

Simple roentgen pictures so obtained are very hard to interpret. The irregularities of the floor and the walls, and the muscular ridges of the bladder give a whole scale of shades and capacities of different degree which make the picture confusing. To overcome this difficulty, the author devised a method to obtain stereoscopic pictures. The distance of the anticathode to the film is 80 cm. Two films in a case are placed under the patient, the tube is focused from 1 to 2 fingerbreadths above the symphysis, and 2 pictures are taken at a distance of 4 cm. from each other. From these stereoscopic pictures, the author constructed models made of paste to illustrate the findings. WERNER M. SOLMITZ, M.D.

Ney, C., Auerbach, O., and Hoen, T. I.: Pseudosphincter in Neurogenic Bladder. *J. Urol.*, Balt., 1947, 57: 858.

During the course of studies on the neurogenic bladder the authors observed a definite sphincter-like structure lying between the internal and external urethral sphincters. To their knowledge, this finding has not been previously described.

This structure, which the authors have designated a pseudosphincter for reasons which will become apparent, was clearly seen in 8 cases of a total of 21 paraplegics studied. It was situated in the prostatic urethra just distal to the colliculus seminalis in the region of the inferior crista. In half of the cases the pseudosphincter was pale with a sharp edge, and although completely surrounding the urethra, its dorsal side more or less tapered into the inferior crista which still could be seen throughout its entirety. In the remaining 4 cases, the pseudosphincter was more fully developed; it was pinkish red with a well rounded corrugated edge, and its dorsal side was raised above the level of the inferior crista which, although obliterated at this level, could still be seen running

distally from the pseudosphincter. In every instance the pseudosphincter projected into the lumen of the prostatic urethra to an extent that made it impossible to be overlooked.

The prostatic urethra, in the 8 cases, was dilated, varying from an early funnel urethra to one with a large saccular dilatation, and the pseudosphincter always formed the distal boundary of the dilated portion. At first it was thought that the pseudosphincter might be a relative structure, formed as a result of disparity between the size of the lumen of the proximal prostatic urethra and its distal portion. Further study obviated this possibility. In the first place, mere dilatation should produce a sphincteric appearance only when looking toward the narrow lumen from the dilated portion, not when viewing the structure from the opposite side. In the second place, 8 other cases with dilated posterior urethras showed only a tendency to pseudosphincter formation; the structure was so poorly defined in these cases that the authors considered it unjustifiable to label it a pseudosphincter. In the third place, in the 8 cases in which it was definitely present, the pseudosphincter was conspicuous under all conditions of examination, i.e., whether the water was running or not, and whether the scope was close to the structure or withdrawn for a distance.

Transurethral resection was performed on 3 of the cases merely to obtain suitable specimens of the pseudosphincter and internal sphincter for microscopic study and not as a method of treatment. These two structures were resected separately and individual bites were removed immediately and not permitted to float back into the bladder. These precautions prevented any possible confusion as to origin of the pieces.

The findings in the 3 cases were similar. Microscopic examination of the pseudosphincter revealed transitional epithelium lining the structure. The wall was composed of loose and dense connective tissue which was hyalinized in areas. There was an extensive acute and chronic inflammatory process with edema which threw the overlying epithelium into folds. The inflammatory cells were densely arranged and located chiefly in the subepithelial tissue, and they were composed of lymphocytes, polymorphonuclear leucocytes, mononuclears, and histiocytes intermingled in a rich number of distended capillaries. The submucosal glands were lined by transitional epithelium and showed marked hyperplasia. There was a small amount of muscle tissue found with Van Gieson stain. Portions of the prostate lying at the base of the pseudosphincter showed evidence of chronic inflammatory processes in which there were periglandular collections of lymphocytes and mononuclear cells, and an increase of interstitial connective tissue. Compared with sections of the internal sphincter taken at the same sitting, the latter was also lined by transitional epithelium showing a similar but less extensive inflammatory process. The wall, however, contained abundant muscle bundles.

JOHN A. LOEF, M.D.

GENITAL ORGANS

Landsteiner, E. K., and Brown, H. P.: Observations on the Treatment of Carcinoma of the Prostate by Orchectomy. *Am. J. M. Sc.*, 1947, 213: 450.

The effects of orchectomy in 35 cases of carcinoma of the prostate were studied. The patients were observed for periods varying from 6 months to 4 years. They varied in age from 53 to 87 years. Of the 35 patients, 20 had a positive microscopic diagnosis of carcinoma of the prostate, while in the remaining 15, the diagnosis was made by physical findings, elevated acid phosphatase, and roentgen ray evidence of bony metastases.

Of the patients having metastases, approximately two-thirds experienced moderate to severe pain preoperatively. In practically all of the cases, surgical castration was followed by amelioration of symptoms within 48 hours. This rapid response suggests that pain as such is due more likely to pressure on or actual involvement of the nerves by carcinoma (usually in the lymphatics or lymph nodes) rather than by intraosseous growth which will show no detectable change by the roentgen ray in so short a time. Little improvement can be expected in cases in which the bony metastases destroy the normal contour of the vertebral column. On the other hand, where pain is caused by peripheral nerve involvement, one may expect relief in a majority of the cases.

Along with other observers, the authors have found that patients who were bedridden and required large doses of opiates were able, in several instances, to resume their former occupations and no longer required sedation.

As might be expected, improvement in well-being and appetite paralleled relief of pain in almost all instances. This improvement may be very rapid and dramatic.

In the present series of 35 cases, 18 patients had evidence of metastases, as seen by the roentgen ray. In the bones there were no constant changes which could be interpreted as signifying regression. Most frequently the osteoplastic metastases became more calcified and appeared more discrete. In a few cases there was no significant change, and two cases only showed decreased density of the osteoplastic lesions with a partial restoration of normal bone architecture.

A very favorable change in the roentgen ray appearance of metastases occurred in one of 2 patients having metastases to the lung fields.

Several patients who showed a progression of metastases by roentgen ray did so in spite of marked clinical improvement.

Although a decrease in size and softening of the original lesion in the prostate was observed in about one-third of the patients treated, only 5 showed a resulting improvement of urinary function and diminished residual urine. This is not surprising when one considers that in many cases obstruction to urination is contributed to, or wholly caused by

benign prostatic hypertrophy, which so often occurs together with carcinoma of the prostate.

The authors are of the opinion that if urinary symptoms are severe enough to suggest need for operative interference, this should be performed at the same time as orchectomy rather than to wait for possible improvement from orchectomy alone.

Of the 23 patients with metastases, 21 had acid phosphatase values above 4 units. All 21 cases displayed a reduction in the acid phosphatase level after surgical castration, 12 of them ultimately returning to normal. In the authors' experience this is of no prognostic significance, since a number of the patients whose acid phosphatase became normal and remained within normal limits succumbed within 3 to 10 months.

Unfortunately, there are few if any clinical or laboratory clues which enable one to foretell how any one patient will respond to surgical castration. The length of time during which a patient may be benefited by castration and remain free of pain varies considerably. The shortest period of improvement among the authors' cases was 3 months, while the longest period of improvement to be followed by relapse lasted 24 months. As a rule, the reappearance of pain was coincidental with a rapid deterioration of the patient's general condition, and was soon followed by death.

The question of the optimal time for orchectomy has remained unanswered. Many urologists advise withholding orchectomy until metastases or symptoms thereof appear. It has been the policy of the authors in most cases to perform orchectomy whenever the diagnosis of carcinoma of the prostate is made, regardless of the presence or absence of metastases. FREDERICK A. LLOYD, M.D.

MISCELLANEOUS

Kretschmer, H. L.: Genitourinary Conditions in Infants and Children. *J. Pediat.*, S. Louis, 1947, 30: 603.

A steady stream of contributions by numerous authors have emphasized that age can no longer be used as an alibi against complete urologic examination in infancy and childhood, as, in general, the indications and contraindications for cystoscopy in children and adults are identical. The increasing enlightenment in the realm of pediatric urology has helped to alleviate suffering in the young and prevent much unnecessary invalidism in adult life.

Anomalies of the urinary tract. With the routine use of intravenous urography, these have been found to be far more common than was formerly supposed. The mere presence of an anomaly does not indicate surgery unless the former has produced changes such as stone, hydronephrosis, and recurring attacks of pyelonephritis. When pyuria persists longer than 4 or 6 weeks despite intensive medical therapy, a complete urological examination should be carried out.

Supernumerary kidney is very rare and has been discovered only in the adult.

Simple renal ectopia or dystopia does not begin to produce symptoms until adult life. The possibility of its occurrence in children should, however, be borne in mind.

Solitary kidney. Symptoms may be pain, hematuria, pyuria, or anuria, and it is important to utilize all modern diagnostic methods so that the condition is recognized, conservative surgery is employed, and the error of removing the solitary kidney is prevented.

Horse-shoe kidney or fused kidney. The author has seen only one child with a fused kidney. This condition is readily recognized in the plain roentgen film or pyelogram.

Renal hypoplasia. The clinical importance of this anomaly is that the small amount of renal tissue present, when bilateral, is not sufficient to sustain life. The hypoplastic kidney is more subject to infection than the normal kidney.

Double kidney and double ureter. Both of these conditions occur quite frequently and often without symptoms. Their mere presence does not indicate operation. In the presence of chronic pyuria, hydronephrotic changes in one-half of the double kidney, and recurring attacks of pyelonephritis, only heminephrectomy will effect a cure. As a rule the upper, and smaller, half of the double kidney is the one harboring the lesion.

Polycystic kidney is rarely seen in children except at necropsy, because clinical manifestations usually do not appear until adulthood.

Solitary cysts of the kidney are rare in children.

Ectopic ureteral orifice occurs more frequently in the female than in the male and is often overlooked for years. The ectopic orifice in the female may be located in the urethra, adjacent to the external urethral orifice, in the vagina, or in the uterus. In the male it may be found in the prostatic urethra, the prostate itself, in the seminal vesicle, or in the vas deferens. A careful history will elicit the fact that the patient is "wet all of the time," losing urine continually, day and night, irrespective of the act of micturition. The diagnosis is made by finding the ectopic ureteral orifice, which, in girls, can readily be located with good exposure, proper light, and a discerning eye. As a rule the ectopic ureter drains the upper half of a double kidney. As a result of this anomaly, this half of the kidney undergoes hydronephrotic atrophy and frequently is infected. The treatment is heminephrectomy.

Ureterocele. Although this condition is relatively uncommon, it is important because of its devastating effect on the kidney. Hydronephrosis is always present due to interference with drainage. When infection is superimposed, chills and fever with marked pyuria lead to a diagnosis of pyelitis; and medical treatment is given for long periods of time to no avail. The diagnosis is readily made on cystoscopy or in the cystogram obtained with intravenous urography, in which a large filling defect appears in the bladder shadow. In early cases the ureterocele is best treated by electrocoagulation or by resection with the resectoscope. In advanced cases with severe hydro-

nephrosis, nephrectomy of the single kidney, and heminephrectomy of the double kidney, may be necessary.

Congenital stricture of the ureter. In the majority of these cases the primary lesion is not at the ureterovesical junction but at the neck of the bladder, with obstruction to urination with hypertrophy of the bladder wall, and a resulting compression of the intramural portion of the ureter. The treatment consists of removing the obstruction at the bladder neck.

Bladder diverticulum is usually overlooked in children because of the absence of a typical symptom complex. Practically all cases are congenital and secondary to obstruction at or in front of the bladder neck. The treatment is directed toward removal of the obstruction. Only in the case of large diverticula, especially when they do not empty and infection persists, is diverticulectomy necessary.

Exstrophy of the bladder. The determining factors in deciding upon operative intervention are the competency of the rectal sphincter in the individual case and whether infection has been introduced into the kidneys. The author prefers to wait until the child is 18 months or 2 years old, and to transplant one ureter at a time.

Obstructions at the vesical neck. These may be of either mechanical or neurological origin. The causes may be located at the bladder neck or in front of it and may be classified as follows: (1) contractures at the internal urethral orifice; (2) median bars; (3) valves in the prostatic urethra; (4) hypertrophy of the verumontanum; (5) lesions of the central nervous system; (6) lesions of the prostate; and (7) extravesical lesions.

The diagnosis can be made from the history and the physical examination. It should be made early before irreversible changes have occurred in the upper urinary tract.

Contractures of the vesical neck may be due to a muscular hypertrophy or a fibrosis of the vesical neck. The obstruction is removed by transurethral resection or suprapubic cystostomy and resection.

Extravesical lesions. Retroperitoneal lesions, such as tumors, both benign and malignant, may produce obstruction with hydronephrosis. As the tumor enlarges a lateral displacement of the ureter occurs.

Congenital valves of the posterior urethra. If this condition is not relieved, the effects upon the upper urinary tract are devastating and irreversible. Congenital valves may be destroyed by the fulgurating electrode or the resectoscope.

Hypertrophy of the verumontanum is often undiagnosed. This condition may produce severe obstruction with a resulting bilateral hydroureter and hydronephrosis.

Lesions of the central nervous system. The common cause of neurogenic bladder disturbance in children is spina bifida, which is usually recognized in the plain roentgen film.

Lesions of the prostate. Sarcoma of the prostate may be mentioned as a rare cause of urinary obstruction in children.

Undescended testicle. An undescended testicle is generally discovered during a routine physical examination by the pediatrician. One must differentiate between a true undescended testicle and a highly retractile testicle. The author believes that true undescended and ectopic testes always require surgical treatment and that endocrine therapy should be avoided because it may result in glandular imbalance or other systemic disturbances.

Surgical tuberculosis of the kidney. Surgical renal tuberculosis can be cured when the process is limited to one kidney, and when the diagnosis is made early the prognosis is excellent. The true incidence of renal tuberculosis is much higher in childhood than the present collected data seem to indicate. One must bear in mind the possibility of renal tuberculosis in children who present persistent pyuria and relapsing pyelitis. If the diagnosis of unilateral, renal tuberculosis is made from the urologic examination, one should rarely resort to retrograde pyelography. Nephrectomy is the proper treatment for unilateral renal tuberculosis.

Urinary calculus is seldom seen in the young in the United States, due to better sanitation, improved diatetics, and better care by the pediatrician, but it does occur frequently enough to warrant its serious consideration. In the very young, the symptoms of stone are abdominal pain, vomiting, diarrhea, and convulsions. As the gastrointestinal symptoms are very prominent, the presence of urinary calculi is not suspected, and they are found only on routine x-ray examination. Pyuria is the major symptom of urinary stone in children. If there is hematuria accompanied by recurrent colicky pain, a stone should be suspected. The pathological changes associated with the urinary calculus are the same in the child as in the adult. The diagnosis and the treatment are also the same.

Hydronephrosis. Before the era of pediatric urology, most of the cases of hydronephrosis and hydroureter were not recognized, and the early literature deals with cases found at autopsy. As in other urologic diseases, it is imperative that early diagnosis be made so that early treatment can be instituted, if irreparable damage to the kidney is to be prevented. As a rule most of these cases come to the attention of the physician after the onset of infection. Because of the presence of pyuria with chills and fever, many of these cases are erroneously diagnosed as acute pyelitis or acute cystitis. Hydronephrosis and hydroureter may result from (1) obstructions in the lower urinary tract anywhere along the course of the urethra from the external meatus to and including the vesical neck; (2) obstruction at the ureterovesical junction; (3) obstruction at the ureteropelvic junction (anomalous vessels are not frequently found as a cause); (4) pathologic conditions extrinsic to the urinary tract (this is rare and when found is generally associated with retroperitoneal tumors); (5) lesions of the central nervous system (spina bifida); the treatment depends upon the cause.

Tumors of the urinary tract. Bladder tumors are rare in childhood. The common tumor in infancy

and childhood is the sarcoma. Unfortunately these cases are usually seen late so that the possibility of surgery effecting a cure is exceedingly remote. Kidney tumors are almost always of the type first described by Wilms, and they are now called Wilms' tumors. They are congenital in origin. Of the three constant symptoms of renal tumors in general, namely, a visible or palpable tumor, hematuria, and pain, only the first is constant in malignant renal tumors of children. The abdomen swells gradually, becoming asymmetrically or symmetrically global. These tumors are usually discovered late because of the absence of pain and hematuria. Differential diagnosis involves excluding other renal lesions, of which hydronephrosis is the commonest, and other retroperitoneal lesions, such as sarcoma and lipoma. In other retroperitoneal tumors the ureter as demonstrated by the shadowgraph catheter is displaced laterally. The diagnosis is based upon the presence of a palpable tumor and changes in the urogram. A plain x-ray of the chest is indicated to rule out metastases. Since the metastases are usually blood-borne, indiscriminate and repeated palpation should be avoided strenuously once the diagnosis has been made.

The author prefers to combine x-ray therapy with operation. A course of deep therapy is given before operation. Although not all Wilms' tumors respond, the majority show a rapid diminution in size. When the tumor no longer diminishes in size, having become stationary, nephrectomy is carried out at once, and this is followed with a course of postoperative irradiation. This technique has resulted in a great reduction of the operative mortality, which today is practically nil, since the diminution in the size of the tumor makes nephrectomy a simple procedure.

FREDERICK A. LLOYD, M.D.

Ferguson, C., and Hershey, T. S.: Streptomycin in Urogenital Infections. *J. Urol.*, Balt., 1947, 57: 932.

The authors studied the results of streptomycin therapy in 44 cases of urinary tract infection, 42 of which were produced by gram negative organisms. Urine was obtained from these patients by thoroughly cleansing the meatus with 1–4000 mercuric alkaline cyanide. The patient was instructed to start voiding. After several ounces were passed, the sterile container was unplugged and the urine was obtained in this manner for culture. This method was found to be more practical than the passage of a rubber catheter, as it is believed the catheter and lubricating jelly offer more opportunity for contamination than the above method.

The first individuals were treated with relatively small amounts of the drug at 3 hour intervals. This method was later changed to a more intensive therapy at 2 hour intervals, and larger amounts of the drug. At the present time the authors are employing 0.2 gm. intramuscularly at 2 hour intervals. They are of the opinion that not less than 5 gm. of the drug should be given in ordinary infections and that those of a severe nature should receive at least 10 gm. Their findings confirm the experience of others that where a local condition exists, such as obstruction in the urinary tract or calculi which have not been removed, the infection may be cleared by streptomycin. It is, however, prone to recur unless the predisposing factors are removed.

The urinary infections studied, on the whole, responded favorably to treatment with streptomycin.

The drug appears to be largely excreted through the urine. A good concentration is obtained in the urinary tract.

An excellent table of the 44 cases treated is appended, in which the diagnosis, the results of cultures before and after treatment, associated local pathology, the immediate and total dosage, and the results of treatment are listed. An interesting observation to be made from a study of this table is in regard to the response of Bacillus pyocyaneus infections to streptomycin therapy. In 18 cases in which this organism was present in pure culture or in a mixed infection, it was eliminated in 11 by a total dosage of the antibiotic, varying from 2 to 10 gm. In all 3 such cases in which 10 gm. were employed the organism was eliminated.

FREDERICK A. LLOYD M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Langenskiöld, A.: Normal and Pathologic Bone Growth in the Light of the Development of Cartilaginous Foci in Chondrodysplasia. *Acta chir. scand.*, 1947, 95: 367.

Under the name of chondrodysplasia, the author includes enchondromatosis and multiple exostosis. A combination of the latter 2 diseases is also referred to as "Ollier's disease" in English and American textbooks.

Roentgenologic studies of Ollier's disease reveals a bony defect either at or near the epiphyseal plate, which grows parallel with the longitudinal trabeculae and appears as if long chips of bone had been surgically gouged out. Histogenetically, these foci represent a disturbance between the epiphyseal plate and the periosteum. Persistence of undifferentiated cartilaginous cells when they migrate toward the diaphysis of the long bones from the fibrocartilaginous epiphyseal plate constitutes nonossified foci in Ollier's disease. In the main, the foci retain their chondrogenic properties instead of merging into the osteogenic layer of the periosteum.

The article illustrates roentgenograms of a child 3½ years of age whose case was followed up for 2½ years. The bones exhibiting the characteristic lesional defects were both ends of the left femur, the lower end of the right femur, both ends of the right fibula and tibia, and the upper half of the left humerus, respectively.

On the pathogenesis of multiple cartilaginous exostoses, the author quotes several writers, one of whom states that "the arrest in the extension of the periosteal ring permits the cartilage of the diaphysial disc to become exposed on the surface of the shaft and thus leaves it uncovered and free to give rise to irregular outgrowths or exostoses."

His own opinion, however, is that there is a disturbance in the differentiation of a limited portion of the undifferentiated connective tissue within the epiphyseal cartilage. Due to failure of this tissue to pursue the laws of normal differentiation, growth, and resorption, isles of exostoses will invariably ensue.

Enchondromatosis differs from Ollier's disease in that it may originate from the epiphyseal plate as well as from the periphery of the metaphysis. Outside of this minute discrepancy, the pathogenesis of the two diseases is quite similar.

Achondroplasia can be elucidated by a periosteal streak which develops in the epiphyseal plate of which the connective tissue layer is saturated with dynamic osteoblastic potentialities. In brief, bone formation ensues in the epiphyseal plate and hence displaces the basic connective tissue (for the continuity of chondrogenic activity) and substitutes premature bone. SAMUEL L. GOVERNALE, M.D.

Fairbank, Sir Thomas: Dysplasia Epiphysealis Multiplex. *Brit. J. Surg.*, 1947, 34: 225.

Fairbank reports a condition which he regards as a clinical entity. The chief characteristics are dwarfism, stubby digits, and mottling or irregularity in density and outline of several of the developing epiphyses.

With regard to the differential diagnosis, there are at least 7 other conditions besides osteochondritis in which the epiphyses may show irregular ossification. Cretinism is the first general condition to be excluded. The fingers are thick and stubby, but fail to show their usual differences in length. Delay in fusion at the epiphyseal line in cretins is associated with sclerosis of the terminal layer of the metaphysis.

In dysplasia epiphysealis punctata (as it is now called), or stippled epiphyses, the whole of an epiphysis seems to be ossifying in a large number of discrete centers. The shafts of the long bones are short and thick, and the ends may be enlarged and splayed. The abnormalities generally are much more gross than in most cases of the multiplex group, and no difficulty should be experienced in differentiating the 2 conditions. Congenital cataract occurs in about half of the cases.

In chondro-osteodystrophy of the Morquio-Brailsford type, but not in gargoylism, as a rule, the femoral heads show striking epiphyseal changes, but in this condition the acetabula are markedly enlarged and irregular. Other epiphyses and the carpal and tarsal bones frequently show irregularity in ossification, but notable features are the abrupt kyphotic deformity in the dorsolumbar region, resulting from the diminution in size of one vertebral body, which is displaced backward, and the shape of the vertebral bodies; in the latter the central prolongation anteriorly is quite distinctive and diagnostic.

In dyschondroplasia, changes in the epiphyses, when seen, are of no importance, as these are completely overshadowed by the gross abnormality of the metaphyses. They are usually, but not invariably, unilateral in distribution. In that skeletal curiosity called osteopoikilosis, the epiphyses are of normal shape, and, whether fused to the shaft or not, show large numbers of the characteristic discrete dense spots, although these are by no means confined to the epiphyses. In osteopetrosis or marble bones, some of the epiphyses may show irregular density or stippling, but the changes in the shafts dominate the picture.

Lastly, mottled epiphyses have been described in association with pituitary gigantism (Traub, 1939). Some mottling, particularly of the femoral heads, has been observed very occasionally in other endocrine disturbances, and in cases which at present cannot be classified.

The author made a study of the characteristics of this condition found in 20 cases. The essential fea-

tures are as follows: it is an affection of children and young people—the ages varying from 6 to over 40 years. One of the cases first seen when the patient was 14 years of age has been followed for over 20 years. Both sexes (12 males, 8 females) are affected and, as a rule, the condition is not inherited or familial. Intelligence is usually normal. In 8 of the cases difficulty in walking was complained of, while in at least 5 others pain and stiffness of the knees or hips was the trouble which caused the patients to enter the hospital. Some degree of dwarfism, of the short limb type, is the rule, it being definitely recorded in 16 of the cases. The facies typical of cretinism is absent. Some enlargement of the epiphyses is occasionally seen. The hands are striking, the fingers and thumbs being short, thick, and stubby with blunt ends, but the relative length of the digits being normal. Apart from the dwarfism and the shape of the hands, there is no characteristic deformity, but flexion deformity of the knees was found in 3 cases, with subluxation in 1 case. In 1 case the elbows were flexed and laxity of the wrists and knees was present. In another, a curious deformity of the elbows was seen, the radial heads being subluxated. In yet another there was limitation of abduction of the shoulders and of extension of the elbows, while the knees were flexed and the tibial heads subluxated backward. Genu valgum was present in 4 cases, and dislocation of the patella, and bowlegs in 1 case each.

The roentgenological findings indicate that the epiphyses may be late in appearing and backward in development, and fusion with the shafts may be delayed, but the principal change is irregularity in ossification. The epiphyses are irregular both in density and shape, being mottled in appearance and perhaps mulberrylike in outline. Separate subsidiary centers around the main center are common, and this results in some peripheral stippling, but this is never carried to the point seen in the punctate type of epiphyseal dysplasia. Eventually the epiphyses become normal in density, but the outline, though usually smooth, remains permanently abnormal. Any or all of the epiphyses may be affected, but the most common to show typical changes and permanent deformity are the hips, shoulders, ankles, and, less frequently, the knees. The heads of the femora (and of the humeri) remain permanently shallow and less convex than the normal.

The ankles show marked obliquity of the joint in the condition under discussion.

The author suggests that if there is reason to suspect pseudocoxalgia in a patient below the average in height, it is well worth while to have films taken of the shoulders and ankle to exclude the developmental error which is the subject of this article.

C. Fred Goeringer, M.D.

Rocher, H. L.: Pleonosteosis; Leri's Disease. (La pléonostéose. Maladie de Léri). *Rev. orthop.*, Par., 1947, 33: 24.

Leri's disease is a congenital osseous dystrophy characterized by premature and excessive development of the epiphyses of the bones of the extremities. The excessive enlargement of the epiphyses causes stiffness of the adjacent joint. The diaphyses are short and hypertrophied. Some epiphyses in the same individual may be underdeveloped. The endochondral ossification of the epiphyseal plates is deranged and results in either hyperplasia or hypoplasia.

Two more cases of this rare disease are added to 2 cases previously reported by the author. A 6 year old boy born to consanguineous parents was brought for examination because of multiple deformities. His birth had been normal, he walked at the age of 17 months, and talked at the age of 1 year. In addition to the joint deformities, there was an umbilical hernia and a left inguinal hernia. The head was large and the root of the nose depressed: there was a dehiscent frontoparietal suture, enlargement of the sella turcica, strabismus, and slight lumbar kyphosis. The corneas were turbid. The joints of the upper extremities were thick, not painful, but showed limited range of motion. The hand was pawshaped and the fingers were kept in slight flexion with extension limited to 10 degrees. The x-ray examination showed a large humeral epiphysis. The diaphyses of the humerus, radius, and ulna, and the metacarpals and phalanges were short and thick. The ossification centers of the carpus were present but small. The ossification center of the distal end of the radius was absent. There was coxa valga without enlargement of the upper end of the femur. The knees were large and their motion was limited to 160 degrees. The ossification center of the upper tibia showed deficiency in its development.

The second patient showed similar findings.

The changes found in Leri's disease could be classified as achondroplasia. The stiffness of the joints, however, which is never observed in achondroplasia, makes Leri's disease a separate entity. The hands, for example, are shaped similarly as the hands observed in achondroplasia. In Leri's disease the joints of the hand are stiff and the range of motion is considerably reduced.

The lack of transparency of the cornea suggests a pathogenic relationship between the ill developed corneal mesenchyme and the irregularly developed preosseous mesenchyme. Heredity did not play any part in the cases presented by the author.

There is nothing known as to the etiology of this condition. In view of the deformed pituitary fossa, a deficiency of the pituitary gland might be an etiological factor. George I. Reiss, M.D.

Platt, Harry: Sarcoma in Abnormal Bones. *Brit. J. Surg.*, 1947, 34: 232.

The author discusses 180 fully documented primary malignant tumors of bone, 161 of which belonged to the sarcoma group, and 18 of these were sarcomas occurring in abnormal bones. This subgroup contained: (1) 10 sarcomas occurring in Paget's disease, (2) 2 sarcomas arising in fibrocystic disease,

and (3) 6 tumors representing the malignant transformation of a previously benign osteochondroma.

The incidence of sarcoma in osteodystrophia deformans has been estimated by various observers as between 5 and 10 per cent. In the present series 8 of the patients were males and 2 females. The malignant tumors appeared in 4 patients between the ages of 50 and 60, and in 6 patients over 60. Four tumors involved the femur (lower end, 3; upper end, 1); 4, the humerus (upper end, 2 in the same patient; and shaft, 2); and 3, the pelvis (ilium, 2; pubis, 1). In the majority of the cases there was a fairly long prodromal stage in which Paget's disease was present either in one bone or throughout a considerable part of the skeleton before the appearance of the tumor. The histologic type of tumor in all cases was a spindle or polymorphic sarcoma.

The prognosis in the sarcomas in Paget's disease would appear to be grave. In 7 of 10 cases in the series the patients died within a year from the discovery of the tumor and its treatment. One patient only, a man of 67 with a sarcoma of the humerus, has so far survived 2 years from the time of amputation. The appearance of sarcoma in an area of fibrocystic disease is a rare phenomenon. In the 2 recorded cases the survival periods were 2 years and 9 years, respectively. In the former, there was an inoperable tumor of the pelvis of gigantic size. At the time of death no evidence of metastasis was revealed.

Because of his experience with these 2 rare cases, the author concludes that it is best to obliterate cysts in adults by appropriate operative procedures (curettage and the implantation of bone grafts). In the type of sarcoma resulting from the malignant transformation of an osteochondroma (6 cases in the series), examples of long survival periods are likely to be encountered. Although rapid growth and the attainment of enormous size are not in themselves conclusive evidence of the advent of malignant change, such tumors should be eradicated without delay. C. FRED GOERINGER, M.D.

Bennett, Granville A.: Malignant Neoplasms Originating in Synovial Tissues (Synoviomas). A Study of 32 Specimens Registered at the Army Institute of Pathology during the Wartime Period from 1941 to 1945. *J. Bone Surg.*, 1947, 29: 259.

During the years of the recent war a large number of neoplasms and neoplasticlike lesions, originating in joints, bursae, tendons, and tendon sheaths, were submitted to the Army Institute of Pathology for interpretation and classification. A review of this material has demonstrated that 32 specimens conform in their cytological and structural features to the malignant neoplasm of synovial membrane origin. An illustrated descriptive analysis of these lesions, together with a tabulation of essential clinical information, forms the basis of this report, which is presented for the purpose of familiarizing both surgeons and pathologists with this important group of sarcomas.

The remaining lesions of synovial origin included numerous examples of the giant cell tumor of the tendon sheaths and joints, pigmented villonodular synovitis, and xanthomatous tumors of the joints. A few representative lesions are illustrated in order to permit a comparison of their microscopic appearances with those of the malignant tumors. Such a comparison would seem appropriate since it has become evident that it is not always easy to distinguish between benign tumorous overgrowths and malignant neoplasms.

There is historical evidence suggesting that, in some instances at least, a malignant tumor (synovioma) may develop in or near a joint or some other synovial lined structure that has been swollen or otherwise abnormal for many months or years. It is highly desirable, therefore, to follow up for subsequent analysis all patients from whom benign neoplasms or other tumorlike lesions of synovial tissues have been removed. Such a study of the vast amount of material now registered with the Army Institute of Pathology should give more precise information as to whether benign lesions may acquire malignant qualities, as well as provide histological criteria which would sharply delineate between the innocent lesions and those that are potentially dangerous.

The usual treatment employed in this series was local excision, followed in many instances by wider excision or amputation at a considerably later date; thus it is essentially similar to that reported in previous studies in which the fatality rate from metastases was exceedingly high.

Because of the demobilization procedures it has not been possible to obtain recent follow-up information in many of the cases of the present series. No progress notes have been obtained from 8 patients. It is known, however, that 11 of the patients died with widespread metastases. In 2 additional patients, metastases are known to be present, and in 3 others recurrences have been reported. This points to the seriousness of this neoplasm and emphasizes the necessity for its prompt and complete removal.

If the present discouraging death rate is to be lowered, there must be closer co-operation between the surgeon and the pathologist. The pathologist must develop skills and techniques which will enable him to interpret these lesions properly, and the surgeon must take the necessary means to eradicate the local lesions without resorting to preliminary conservative measures. RUDOLPH S. REICH, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

De Anquín, Carlos E.: Mommsen's Osteotomy as a Palliative Operation on the Hip (La osteotomía de Mommsen entre las operaciones paliativas de la cadera). *Rev. ortop. traumat.*, B. Air., 1946, 16: 21.

Because of the destructive character of congenital hip lesions, total reconstruction is impossible.

Fig. 1 (De Anquin). The excellent results from Mommsen's osteotomy.

Hence only palliative intervention is indicated. Kirmisson, in 1892, utilized a subtrochanteric oblique osteotomy for the correction of this lesion. Lorenz and Baeyer simultaneously proposed bisection of the femur and anchorage of the superior fragment by utilization of the pelvitrochanteric muscles. The lower section of the femur was placed in 45 degree abduction and in from 5 to 20 degrees of hyperextension. With this procedure they created a Y-shaped femur. Schanz bisects the femur at the level of the ischium, using this structure for support of the femur.

The bad features of each repair are discussed and the author believes that Mommsen's method satisfactorily overcomes these. He describes the technique in detail. A 12 cm. incision is made over the external part of the femur so that the part to be resected is at the level of the ischium. This is determined with x-ray views. The femur is transected from without in as far as the medulla and again outward from within several centimeters lower.

The 2 parallel cuts are joined by a perpendicular one. The lower part of the femur is now abducted, and a body cast which incorporates the leg is applied and left in place for from 10 to 20 weeks.

A case report is presented. The accompanying illustration shows the excellent end results.

STEPHEN A. ZIEMAN, M.D.

Wilson, Philip D.: Trochanteric Arthroplasty in the Treatment of Ununited Fractures of the Neck of the Femur. *J. Bone Surg.*, 1947, 29: 313.

The term "trochanteric arthroplasty" is used in this article to designate an operation on the hip, in which the head and neck of the femur are removed and the trochanteric end of the shaft of the femur is reshaped, covered with a vitallium cup or mold, and then placed in the acetabulum. As a preliminary step, the tip of the greater trochanter is cut away from the rest of the femur, the attachments of the gluteus medius and gluteus minimus being preserved. This fragment is later transplanted to the shaft of the femur distal to the greater trochanter.

The operation is a development of the ideas of Whitman, Colonna, and Smith-Petersen.

The various steps of the operation are clearly shown in illustrations accompanying the article.

The hip is maintained in a position of abduction and extension for a period of from 4 to 6 weeks, generally in a plaster-of-Paris spica. The knee joint may be freed at a considerably earlier period to permit mobilization and exercises. Following removal of the plaster, mobilizing exercises of the hip are started. Weight bearing is not permitted until the end of from 8 to 10 weeks, and then only with crutches.

The chief complication that must be guarded against is luxation, particularly during the first 2 weeks after the plaster is removed.

A summary of 9 cases in which operation was performed by this method shows the results were excellent in 4, good in 2 cases, fair in 1 case, and poor in 2 cases.

The writer does not propose trochanteric arthroplasty as the proper method of treating all ununited fractures of the neck of the femur. However, trochanteric arthroplasty has two advantages over the usual arthroplasty of the femoral neck. First, it eliminates the neck of the femur and, for an angular thrust, it substitutes a direct vertical thrust in the axis of the femur. This simplifies the mechanics of hip function and reduces the likelihood of instability due to insufficiency of the iliofemoral muscles. Second, there is a more abundant blood supply to the trochanter than to the femoral neck, hence there is less chance of postoperative absorption of bone, which is frequently a troublesome feature after arthroplasty of the femoral neck.

These advantages are sufficient to more than counterbalance the single disadvantage, which is the tendency of instability of the hip in the early postoperative period, and the necessity of taking certain precautions to guard against luxation. Perhaps eventually a way will be found to make these hips more stable by surgical implantation of a bone shelf.

While trochanteric arthroplasty is particularly indicated in the treatment of certain ununited fractures of the neck of the femur, it is also of value in many other pathological conditions of the hip, especially those accompanied by destruction of the head and neck of the femur.

RUDOLPH S. REICH, M.D.

Parker, J. M., and Modlin, J. J.: Compound Injuries of the Knee Joint. Study 2—The Infected Knee Joint. *Ann. Surg.*, 1947, 125: 385.

World War II has witnessed a significant change in the surgical treatment of severely traumatized and infected knee joints. Rather than merely the saving of a limb or a life, the conservation of function has become the goal. The conclusions are based on cases seen at the Twenty-first General Hospital, St. Louis, Missouri (Washington University Unit) during the African, Italian, and French campaigns. Established infection can be controlled and a functioning joint obtained by (1) removal of all actually or potentially devitalized tissue and foreign material which can serve as foci of infection; (2) control of the residual infection by the systemic and intra-articular use of penicillin; (3) closure of the knee joint to exclude reinfection from without, and to insure retention of the penicillin; (4) the institution of early, active motion.

The infected joint most amenable to the therapy outlined by the authors is the one with minimal fracture rather than one with extensive fractures and soft tissue loss. A total of 244 penetrating and perforating wounds of the knee joint were treated. Clinical infections developed in 29 of these. The infections are classified as acute, subacute, and chronic, the latter being most subtle and most likely to escape diagnosis.

The gross pathology of the different stages is described. Attention is called to the menisci which early appear viable, but in later stages degenerative signs such as dullness, softening, and yellow discoloration are frequently noted. In the chronically suppurating joint, menisci are generally found to be degenerated, erosion of opposing cartilaginous surfaces is present, and the joint cavity is partially obliterated by adhesions.

By arthrotomy, and by observing the criteria mentioned herein, the authors believe that definite advantages were gained over prior methods of drainage and immobilization. Of the 15 patients selected for this method of treatment, 14 were considered to have had a successful result, from the standpoint of arrestment of the infection and preservation of a serviceable knee joint.

Although basic tenets were débridement, including excision of the menisci, closure of the joint, and instillation of penicillin, the extent of débridement varied in the different stages of the infected knee. In the acute septic knee, menisci were removed by medial and lateral parapatellar incisions despite appearances because of known low vitality and susceptibility to infection, as indicated from the study of knees in the later stages. In the subacute stage, the meniscus on the side of the injury was removed, and decision as to removal of the opposite meniscus was made upon examination at surgery. With developing chronicity, good functional results are less frequent. Usually both menisci are found to be degenerated and areas of necrotic cartilage are present. In such cases the menisci are removed and devitalized cartilage is curetted to good bone. If the procedure is too extensive to expect minimal joint function, resection of the joint may be performed.

Both menisci were removed in 8 of the 15 patients; the lateral meniscus alone was removed in 5, and the medial meniscus was excised in 2 patients.

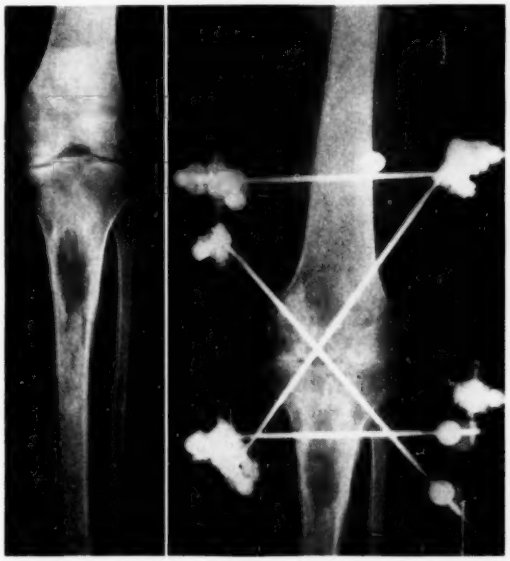
The remaining 14 infected knees in the series of 29 cases were considered too extensive to be amenable to arthrotomy and débridement. Four of these knee joints were resected to control infection. One of the patients in whom resection was done required subsequent amputation to control fulminating osteomyelitis.

KENATH H. SPONSEL, M.D.

FRACTURES AND DISLOCATIONS

Stark, W. J.: The Value of External Skeletal Fixation in Elective Orthopedic Surgery. *Ann. Surg.*, 1947, 125: 372.

The Roger Anderson apparatus has been used frequently for the treatment of fresh fractures, but the present study comprises 57 elective orthopedic procedures in which it was used (bone grafting to old



a b

Fig. 1 (Stark). a, Roentgenographic appearance of knee joint 10 months following a compound fracture of the tibia (gunshot wound) involving the knee joint originally with oesteomyelitis and septic arthritis. b, Anteroposterior view of a surgical arthrodesis of the knee joint 10 weeks postoperatively. Early union is present. Immobilization discontinued in 14 weeks, when ankylosis was complete. Four 5/32 inch pins are used and their position is clearly indicated in the roentgenogram. The two oblique pins cross through the knee joint. The articular cartilage is removed from opposing joint surfaces before these oblique pins are inserted.

a b c

Fig. 2 (Stark) a, Roentgenograms of a compound fracture of the tibia 10 months following gunshot wound. There had been continuous immobilization since this patient was wounded, including 3 months in a walking plaster. The skin wound had been healed for 8 months. b, Roentgenographic appearance 12 weeks after a sliding bone graft with additional cancellous bone from the opposite tibia. Immobilization discontinued in 16 weeks with union present. c, Photograph of the patient after surgery.

nonunions, arthrodeses, and humeral shortenings). The bone grafts were all full-thickness onlay or inlay grafts, all cancellous grafts being reported separately.

The appropriate size of pin is used for each bone or joint; from a 5/32 inch pin for the tibia and femur, to a 3/32 inch pin for the wrist joint. Pins are inserted by a slow speed hand drill to eliminate thermal damage to tissue. Anatomically correct sites must be chosen for the insertion of pins to avoid pin seepage. Pins are inserted before the operative incision is made. In the femur and tibia, through and through pins are used with the half-pin units. After exposure of the site the desired position is secured and maintained by locking the clamps. Application of a graft is then simple. Sterile gauze is secured about the pins and changed infrequently; plaster dressings are not used. Most of the lesions in the author's series were old gunshot wounds, many of which had been infected. Periods of fixation ranged from 20 weeks for the average bone graft to the femur to 12 weeks for a graft to the radius. Similarly, the average fixation period for arthrodeses was 20 weeks for an elbow to 12 weeks for a wrist.

A representative group of cases is presented, together with photographs and before and after roentgenograms showing the apparatus *in situ* after union had taken place. Pin seepage occurred in 21 per cent of the cases. It is differentiated from infection about the pins, which did not occur in this series, and is due to movement of the soft tissues around the pin. All pin tracts were healed in from 7 to 15 days. No sequestra or osteomyelitis occurred at pin sites. There were 2 cases of delayed union. In 4 cases there was exacerbation of infection in the old compound wound which healed again in from 3 to 8 weeks without involvement of the operative site. Infection of the surgical wound occurred in a mental patient, but eventually cleared, the graft remaining in place. No renal calculi were present in the group.

The advantages of external skeletal fixation are: (1) continuous rigid fixation of the fracture site; (2) simplification of the operative procedure and elimination of the need for plaster casts; (3) early active mobilization of the adjacent joints; (4) early ambulation is permitted (8 to 10 weeks of weight bearing with pins in place); (5) a minimum of nursing care is required and patients are reasonably comfortable. The disadvantages are the dangers of complications as noted above. FRANCES E. BRENNECKE, M.D.

Allaria, A.: Fracture of the Acromion (Le fratture dell'acromion). *Chir. org. movim.*, 1946, 30: 425.

In the author's material of 13,860 fractures there were 133 fractures of the scapula (0.98% of all cases). Fracture of the acromion was diagnosed in 18 cases

(13.23% of all fractures of the scapula, or 1.29 per 1,000 of the entire fracture material).

The differential diagnosis should consider: (1) so-called "acromial bone," or "Rüge's bone," resulting from a deficient process of ossification; and (2) sesamoid bone, namely the acromial and/or secondary acromial bone.

As to the mechanism of the fracture, direct trauma was responsible for 72.7 per cent of the fractures of the acromion, while indirect trauma to the elbow or the forearm was responsible for the remaining cases.

Inspection of the shoulder from the back reveals tumefaction in the injured region. Not infrequently, characteristic ecchymoses in the acromial region are present. Palpation is painful and inspiration frequently provokes pain, but the functional examination may fail to furnish distinct results. From the anatomopathologic and roentgenographic point of view, fractures of the acromion may be divided into three groups: (1) fractures of the distal extremity, (2) fractures of the articular or acromioclavicular portion, and (3) fractures of the base of the bone. The first two types are relatively rare.

As to therapy, bandaging of the arm to the trunk is sufficient if the fragments are in good apposition. Otherwise, immobilization of the arm in the position of abduction and intermediate rotation with the elbow flexed to 90 degrees is suggested by the author. If the fracture is combined with a dislocation, the latter should be reduced first. In exceptional cases introduction of a wire and the application of traction, or an open reduction may be required.

JOSEPH K. NARAT, M.D.

Piqué, José Alberto: Treatment of Old and Painful Bilateral Congenital Dislocation of the Hip (A propósito del tratamiento de la luxación congénita bilateral Inveterada y dolorosa de la cadera). *Rev. ortop. traumat.*, B. Air, 1946, 16: 65.

Any treatment for old congenital dislocation of the hip should take into account regional anatomy, the type of luxation, the mechanical changes which occurred during the early stages, and the presenting acute symptoms. There are two main types of congenital dislocation of the hip: (1) the anterior or supra-acetabulum dislocation which has 5 subtypes, and (2) the posterosuperior, which has 2 subtypes, the intermediary and the high.

The regional anatomical changes, together with the different types of dislocations, produce in time a series of disturbances which are conditioned by 4 factors: (a) insufficient, or absence of, femoral stability; (b) bad orientation of the bony parts; (c) shortening disproportion of the extremities; and (d) displacement of muscular insertions while walking. The clinical symptoms are pain, fatigue on walking, slowing of gait, and defective posture.

Certain cases of old dislocations are not amenable to surgical treatment, and nonsurgical procedures should always be tried before resort is made to any open method. These include rest, and the use of orthopedic appliances, medicine, and physical therapy. Surgical treatment employs palliative and definitive methods. Palliative treatment is divided into intra-articular, extra-articular, and complementary operations. The intra-articular operations include resection of the head of the femur, pseudarthrosis of the femoral neck, and arthrodesis.

The extra-articular operations are the various osteotomies aimed directly at correction of the adduction or correction of the flexions on the one hand, and those for the purpose of stabilizing the pelvis, such as the Lorenz bifurcation method, or the Schanz ischial attachment, and their modifications.

The complementary operations are designed for the correction of the inequality of the extremities by lengthening the short member or shortening the longer one, or by harnessing the fragments.

STEPHEN A. ZIEMAN, M.D.

Leveuf, J., and Pais, C.: Congenital Dislocations of the Knee (Les dislocations congénitales du genou). *Rev. orthop.*, Par., 1946, 32: 313.

The authors differentiate between 3 varieties of anterior displacement of the knee:

1. Congenital genu recurvatum, in which the articular surface of the tibia glides anteriorly on the femur but the contact of the articulating surfaces of the tibia and femur remains preserved.

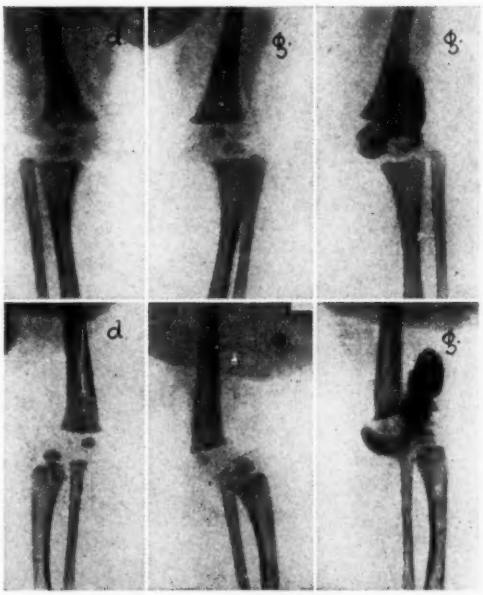


Fig. 1 (Leveuf). Bilateral subluxation of the knee. The arthrogram of the left knee shows the partial loss of contact between the articular surfaces and the overriding of the cartilaginous epiphyses.

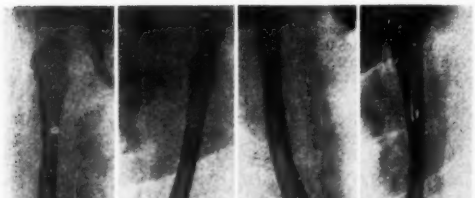


Fig. 2 (Leveuf). Subluxation of the right and luxation of the left knee. Luxation of the left hip. Anterior and external overriding of the tibia and hypoplasia of the epiphyseal ossification center of the metaphyses and diaphyses of the left femur.

2. Congenital subluxation in which the posterior part of the tibial epiphysis articulates with the anterior surface of the trochlea of the femur. The tibial epiphysis is displaced anterior to the epiphysis of the femur.

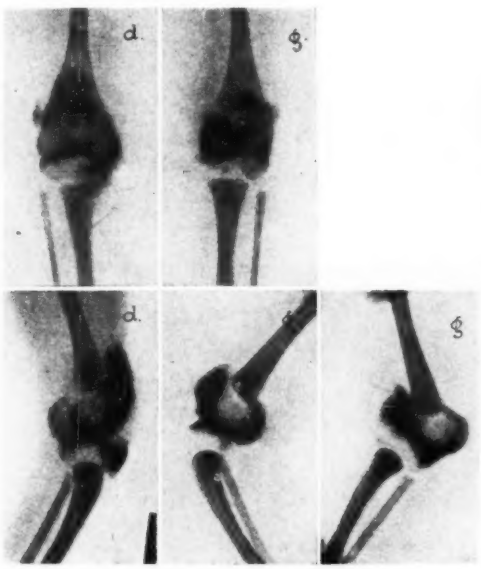


Fig. 3. Arthrogram of the left genu recurvatum well visible in hyperextension: hypoplasia of the capsule and cartilaginous deformation of the tibial epiphysis in the form of "donkey back."

Fig. 4. Arthrogram showing subluxation of the right side during hyperextension and luxation of the left side with marked overriding and interposition of the subpatellar synovial membrane and hypoplasia of the capsule.

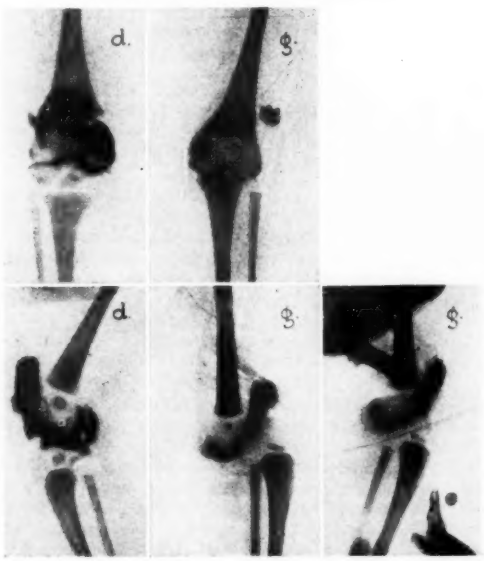


Fig. 5. Arthrogram of subluxation of the left knee. Overriding of the cartilaginous epiphyses which are hypoplastic. Articular cavity decreased. Convexity of the tibial epiphysis displaced superiorly and anteriorly, even during attempts of reduction (last picture).

3. Complete congenital luxation in which no contact exists between the articular surfaces of the two bones. The tibia is dislocated not only anterior but also lateral to the femur.

Since the epiphyses are cartilaginous and transparent to the x-rays in the newborn, simple roentgenography gives only an incomplete picture of them and of the degree of subluxation or luxation. Arthrography (filling of the glenoid cavity with a contrast medium) permits visualization of the contours of the epiphyses, of the whole extent of the joint cavity with its recesses (subquadricipital, subpatellar, and popliteal), and of the soft tissues inside the joint (anterior adipose pad, menisci, thickening of the synovia).

There is atrophy and deformation of the epiphyses of the femur and tibia. The quadriceps muscle is atrophic and shortened. In many cases the patella is atrophied and in some cases it is missing. Microscopically, the muscles present fatty infiltration, thickening of the perimysium, and sometimes cloudy swelling.

Little is known about the etiology and pathogenesis of this malformation. Just as congenital dislocation of the hip joint, congenital dislocation of the knee occurs about 2 or 3 times more often in girls than in boys. About 60 per cent of the cases in the literature showed other malformations besides dislocation of the knee. Most frequent among these were luxations of the hip, and in 10 per cent pes equinovarus was present. Other cases showed spina bifida, anal atresia, harelip, and strabismus.

In genu recurvatum it is sufficient to immobilize the knee in a cast for 2 or 3 months. Subluxation and luxation require either orthopedic reduction or surgery. Orthopedic reduction should be done only under roentgenoscopic control, immediately after the arthrogram has been taken. In attempting to reduce the luxation, one has to proceed very gently as the danger of separation of the epiphysis is great. In surgical reduction, the most important step is the lengthening of the extensor apparatus, either by a simple Z-formed incision of the quadriceps tendon or, if the shortening of the quadriceps is very marked, by more complicated techniques which are discussed in detail. In addition, in cases of luxation it is necessary to open the capsule and to remove the hypertrophic tissue of the synovial membrane between the patella and the tibia.

The authors discuss 5 cases observed by them.

WERNER M. SOLMITZ, M.D.

ORTHOPEDICS IN GENERAL

Cheynel, J.: A Study of the Physiopathology of the Hip Joint (Recherches sur la physio-pathologie de la hanche). *Rev. orthop.*, Par., 1947, 33: 7.

Examination of the round ligament in 50 autopsies demonstrated its variation as to length and size. A round ligament, however, was found in every hip joint. An opaque substance was injected into the iliac artery of fresh adult, children, and newborn cadavers and the hip joint was then x-rayed. A histologic examination was also made of every round ligament.

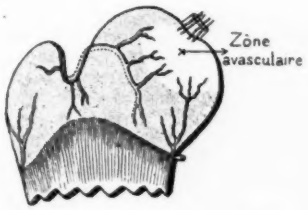


Fig. 1 (Cheynel). The femoral head in the newborn.

In the newborn a number of arterioles were found to be located at the periphery of the round ligament. These vessels, however, do not penetrate into the still cartilaginous femoral head. In the adult, several (about 5) arteries were found to traverse the round ligament in its entire length, converge, and penetrate into the osseous portion of the femoral head. In the aged, the round ligament showed very poor vascularization. The roentgenograms of the specimens supported the histologic findings. In the adult a definite anastomosis existed between the vessels of the round ligament and the anterior and posterior circumflex vessels. There were a few neurofibrils at the periphery of the round ligament which obviously were of little clinical significance.

The femoral head gets its blood supply from 3 sources: the obturator artery, through its arterioles within the round ligament, and the anterior and posterior circumflex arteries. In the newborn the anterior circumflex artery fails to supply branches to the femoral head. The posterior circumflex artery before penetrating the femoral head follows a spiral course around the posterior aspect of the head (Fig. 1).

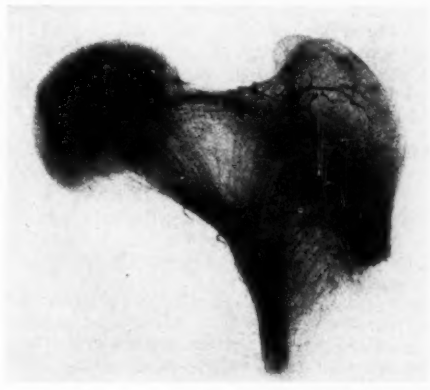


Fig. 2. The paucity of the intrinsic circulation in an individual 70 years of age.

The posterior circumflex artery gives off branches along its course. It never communicates with the round ligament vessels in the newborn. Thus, an avascular area is formed in the superior medial corner of the femoral head which is the exact site where the ossification center seems to appear at the age of 16 to 18 months. In the adolescent, anastomosis between the 3 systems seems to increase more and more (beginning between the ages of 10 and 12 years). In the adult definite and extensive communication between the 3 vascular systems is established.

The anterior circumflex artery gives off a recurrent nutrient branch (Nussbaum) which enters the femoral neck to anastomose with branches of the posterior circumflex artery. The posterior circumflex artery gives off 3 sets of branches: (a) at the inferior border of the femoral neck, i. e., inferior nutrient vessels of the head and neck (Lexer, Waldenstrom); (b) branches that enter the posterior aspect of the neck; and (c) superior branches which clinically are the most important. One branch is a recurrent trochanteric branch, and 3 large branches enter the head and neck. The arterioles of the round ligament communicate with the superior and inferior nutrient arteries of the posterior circumflex artery. In the adult there is no avascular zone in the femoral head. In the aged, roentgenograms of the injected specimens clearly show the paucity of the intraosseous arteries of the femoral head, and the lack of anastomosis of the round ligament arteries with the other vascular systems (Fig. 2).

Osteochondritis dissecans of the femoral head (Konig's disease) in which a small superficial osteocartilaginous sequestrum is formed is caused by a disturbance of the vessels of the round ligament, i.e., endarteritis obliterans, embolism, or spasm. A similar vasomotor process is most likely responsible for similar conditions in other joints, for example, the shoulder, elbow, and knee.

A similar process causes Legg-Calve's disease in the hip joint. Anastomosis of the vascular system of the round ligament and the posterior circumflex artery is not established before the age of 10 or 12. It is possible that vasomotor disturbances of the round ligament arteries are responsible for these changes. GEORGE I. REISS, M.D.

Wilkinson, W. R.: Coccygodynia; Review of the Literature and Presentation of Cases. *South. Surgeon*, 1947, 13: 280.

Coccygodynia means painful coccyx, but the term refers to a clinical entity which may include other symptoms. This condition may well be called pelvic myoneuralgia.

To understand the relationship of the lesion to the symptoms, the anatomy of the pelvis must be known. The muscles involved are the piriformis, coccygeus, and levator ani, which are components of the pelvic floor. The piriformis muscle is in close relationship in a variable manner with the sciatic and gluteal nerves. The coccygeus and levator ani have attachments on the coccyx. The writer further expands on the extensive pelvic innervation. From the anatomic descriptions, it can readily be understood that inflammation of any of the pelvic viscera can cause spasm of those muscles mentioned here, thereby giving rise to the symptoms of coccygodynia.

At the Laird Memorial Hospital, Montgomery, West Virginia, 20 of the last 23 cases observed were in females. Other writers have reported corresponding ratios.

The author states that the symptoms of coccygodynia are the result of an imbalance of the pelvic musculature. Pain may be referred to the coccyx, anorectum, pelvis, or the supragluteal, lumbar, and perineal regions. Many combinations, and occasionally simply coccygeal pain, may obtain. The author attributes most of the cases of coccygodynia to inflammation of the pelvic organs in both men and women. Trauma and psychogenic factors account for a small percentage of cases. It is more likely that neurosis is a result, rather than a cause, of coccygodynia.

The diagnosis may be suspected in any patient complaining of rectal or coccygeal pain, or any combination of the previously mentioned symptoms. The most common physical finding is a spasm of one or more of the muscles of the pelvic floor. The affected muscles have a swollen, beefy feel to the examining finger on rectal examination. Spasm of any of the subject muscles can cause the pain due to muscle imbalance. If there is severe unilateral spasm, the stool may take on a triangular shape. In prolonged, untreated cases the affected muscle will become small and feel not unlike bands of banjo strings. The examination, by pressure on the affected muscle, may elicit pain duplicating the patient's complaints. Local and remote foci of infection should be sought and corrected. X-rays contribute nothing to the diagnosis.

The author believes that the treatment of coccygodynia is entirely nonsurgical. There is no indication for excision of the coccyx for coccygodynia per se. The treatment is massage. This is accomplished as for a rectal examination, and the finger massages the muscle in the direction of the fibers, which causes rather severe pain at first, so gentle massage, followed by increasing pressure as the pain diminishes, is the method of choice. Too vigorous massage may cause hemorrhage into the muscles. Three treatments per week of about 2 to 3 minutes each give the best results. The number of treatments is dictated by the progress of the patient. The average number in the present series was 15.

Other aids in treatment include a sitting posture to avoid pressure on the coccyx, heat, and especially relief of constipation.

Follow-up in 8 of the last 12 patients operated upon for excision of the coccyx indicates that only 1 obtained relief. The last 11 patients were treated by massage, and 8 were relieved. Two of the 11 were advanced cases, having gone to the banjo string stage. KENATH H. SPONSEL, M.D.

Lacroix, P.: Stimulation of the Longitudinal Growth in the Tibia by Elevation of the Diaphyseal Periosteum (Excitation de la croissance en longueur du tibia par décollement de son périoste diaphysaire). *Rev. orthop.*, Par., 1947, 33: 3.

Partial operative arrest of growth of the longer extremity for equalization of length of both extremities has been successfully used in children for some time. Many workers devised numerous procedures, such as insertion of foreign bodies near the epiphyseal plate, or curettage of the marrow cavity through a window to excite increased growth in a long bone of the shorter extremity, but all these attempts failed.

The author stripped the entire periosteum of the tibia in 10 rabbits. An increase of growth was observed from 0.5 to 4.5 cm. within from 20 days to 5 months. A similar observation was made by Ollier in the year 1867. However, it is suggested that a great deal of further investigation is necessary before much significance can be attributed to these experiments.

It is believed that an increased blood supply alone cannot be responsible for the increased growth because lumbar sympathectomy did not cause an increase of growth in young individuals, although it caused an increased blood supply to the lower extremities.

The author suggests that venous stasis exerts a definite stimulating influence on osteogenesis. Ligature of the large veins in the extremities accelerates callus formation (Pease and Morton, McMaster, Roome). The increase of reparative osteogenesis would, however, not explain the increase in length of the long bones. Bergman and Kishikawa stated that venous stasis has no definite influence on the epiphyseal plate.

The author has recently demonstrated that there are organic substances which act on the enchondral ossification of the epiphysis. It is possible that by stripping of the periosteum an increased amount of this substance is liberated. It is further assumed by the author that the osteogenic powers of the periosteum are stimulated by the same substances that act on the epiphyseal plate. This hypothesis might also help explain the increased longitudinal growth of bones in which the diaphysis had been the site of fractures or had been used as a donor site for a bone graft (Compere and Adams, 1937).

GEORGE I. REISS, M.D.

SURGERY OF THE BLOOD AND LYMPH SYSTEMS

BLOOD VESSELS

Massell, T. B.: The Fluorescein Wheal Test for Collateral Circulation in the Preoperative Evaluation of Patients with Aneurysms and Arteriovenous Fistulas. *Surgery*, 1947, 21: 636.

Operative cure of an arteriovenous fistula of a major artery frequently necessitates quadruple ligation of the component arteries and veins. In order to avoid gangrene, it is necessary to be sure that the collateral circulation is adequate prior to the operation. Clinical observation of evidence of a large fistula and accurate localization of the lesion in relation to the collateral arteries give some clue to the state of the collateral blood supply, but a more definite test is necessary.

The Matas-Moszkowicz flushing time gave variable results with different observers. The Matas compressor would slip as the position of the extremity was changed so that blood flowed through a supposedly occluded artery.

A new method for testing the collateral circulation which was based on the use of wheal fluorescence was devised. The aneurysm is occluded by a Matas compressor. A series of parallel scratches is made less than 8 cm. apart, both on the involved and on the opposite extremity. Ten cubic centimeters of 10 per cent fluorescein are injected into an arm vein and the level of wheal fluorescence is examined by filtered ultraviolet light. If the collateral circulation is adequate, the lowest level of fluorescence should not be more than 8 cm. higher on the involved extremity than on the normal side.

Twenty-eight patients with aneurysms or arteriovenous fistulas were examined before operation by this technique and by the Matas-Moszkowicz test. Wheal fluorescence seems to have the following advantages over the flushing time test for the collateral circulation.

1. Wheal fluorescence provides a clear and definite end point which is not subject to individual variation depending on the person who performs the test.

2. There is no arbitrary time limit. The criterion of normal value is provided in the opposite extremity in each observation.

3. Since the extremity does not have to be moved during the test, there is less danger of error from slipping of the compressor.

4. The fluorescein wheal test requires a briefer period of arterial compression than the flushing time technique and is therefore less painful to a hypersensitive patient.

Certain defects common to both tests were pointed out by the author. The improvement in the collateral circulation following sympathectomy was measured with both of the tests.

THEODORE B. MASSELL, M.D.

Rector, E. W.: Evaluation of the Basal Vascular Tone Test as an Indication for Sympathectomy in the Treatment of Surgical Lesions of the Major Arteries. *Surgery*, 1947, 21: 630.

The development of the collateral circulation after ligation of a major artery may often be aided by sympathectomy performed previous to or at the same time as the arterial ligation. The benefits of sympathectomy are most marked in the patients in whom the vasomotor tone is increased.

Following the technique of Naide and Sayen, measurements of the skin temperature were made with the aid of a galvanometer in a constant temperature room at 20°C, and 40 per cent humidity. The digital skin temperature was measured at the start of the test and every 10 minutes thereafter. The values of the skin temperature readings obtained 30 minutes after the patient was admitted to the constant temperature room served as a final reading.

The clinical evidences of increased vasomotor tone were also observed, i.e., cyanosis, sweating, and constricted veins. The results of the test were compared with the clinical impression in 45 patients. There was agreement in 32 cases. In 10 of the 13 cases in which there was disagreement it was possible by analysis of the end results to compare the value of the two methods. Clinical judgment was found to be superior to evaluation by the basal vascular tone test in 8 of the cases, while in only 2 cases the test for basal vascular tone proved to be superior to clinical appraisal of the patients.

The author points out that his patients were vigorous, young individuals, all of whom had sustained local trauma to the blood vessels. The original work of Naide and Sayen was based on an older group of individuals with arterial occlusions of more gradual onset.

In order to explain the discrepancy between the two reports it is suggested that abnormal vasoconstriction may be induced by local trauma and that this segmental arterial spasm may be quite independent of the general vasomotor tone.

THEODORE B. MASSELL, M.D.

BLOOD; TRANSFUSION

Swedberg, Birger; Windström, Gösta; and Alin, Knut: The Importance of Aseptic Technique and the Fallaciousness of Chemical Bacteriostatics in Blood Banking and Plasma Preserving. *Acta med. scand.*, 1947, 127: 480.

The authors describe the work done elsewhere on bacteriostasis in blood preservation. In connection with the production of plasma for military use in Sweden during the period from 1943 to 1944, a very open method of blood drawing and plasma separation was used with the great possibility of consequent bacterial contamination. By the addi-

tion of sulfathiazole, 100 mgm./100 c.c., and rapid cooling of the blood and with plasma preparation within 5 days it was believed that bacterial growth in the blood might be prevented. The plasma was stored, when ready, at between −15 and −25°C. and sterilized by filtration immediately before drying. The clinical results with this plasma were generally good. However, plasma which was undried showed almost constantly bacterial and fungoid growth after from 12 to 18 months. When contaminating organisms are found they are generally resistant to sulfathiazole even in concentrations of 500 mgm./100 c.c.

The authors re-emphasize the importance of aseptic methods from the moment of blood collection to the dispensation of the finished plasma. No bacteriostatic agent can take the place of aseptic technique.

EDWARD H. CAMP, M.D.

Muirhead, E. E., Small, A. B., and McBride, R. B.: Peritoneal Irrigation for Uremia following Incompatible Blood Transfusion. Report of a Case. *Arch. Surg.*, 1947, 54: 374.

The authors report a case of uremia following incompatible blood transfusion which was successfully treated by peritoneal irrigation. The method used by Frank, Seligman, and Fine, in acute renal failure following sulfathiazole therapy, was utilized.

Through a clerical error a white female patient aged 36 received an incompatible blood transfusion. For 16 days following, and prior to the institution of peritoneal irrigation, the patient's condition gradually deteriorated, the azotemia became progressively worse, and the signs and symptoms of grave uremia followed. The prognosis was such that the patient was not expected to survive.

Peritoneal irrigation with a sump aspiration drain in the right lower quadrant and a No. 18 rubber French catheter in the left upper quadrant was then employed for 6 days. The solutions used were several of the crystalloid types containing heparin and penicillin. Substantial amounts of urea were obtained by this extrarenal route, and the azotemia was promptly and greatly relieved. Subsequently the kidneys cleared large quantities of urea from the body, but polyuria was necessary, as the urea clearance remained depressed.

Overhydration constituted one of the main complications as the kidneys were unable to rid the body of water. This condition was apparently aggravated by the use of Tyrode's solution and an isotonic solution of three chlorides in the peritoneum. Recovery was associated with the loss of water and salt from the body, while dextrose in distilled water was used for peritoneal irrigation.

A low grade peritonitis was controlled by parenteral and intraperitoneal streptomycin. Circulatory failure associated with oligemia was successfully treated by the intravenous administration of blood, plasma, and electrolytes. The patient left the hospital 38 days after the reaction and her urea clearance at the time of discharge was 53 per cent of normal.

EDWARD F. LEWISON, M.D.

MISCELLANEOUS

Cartwright, G. E.: Dietary Factors Concerned in Erythropoiesis. *Blood*, 1947, 2: 111, 256.

Knowledge concerning the production of the red cells is not nearly as complete as that concerning their destruction. Although hemin has been synthesized in vitro by Fischer and Zeile, there is little evidence to indicate that such steps take place in vivo. It is the purpose of this review to describe those dietary factors now recognized as necessary for erythropoiesis, and to discuss the present knowledge concerning them.

The known factors concerned in the formation of the red cell may be divided into three groups: vitamins, amino acids, and minerals. Because of our lack of knowledge, it will be necessary to consider the formation of the erythrocyte and hemoglobin as one process, erythropoiesis.

VITAMINS

Riboflavin, nicotinic acid, pyridoxine, and the various folic acids are important for red cell formation in at least one species each.

A. The role of riboflavin in blood regeneration in dogs on a purified ration has been studied by Spector, Maas, Michaud, Elvehjem, and Hart, and they concluded that it plays a role in determining the size of new red cells. Wintrobe, Bushke, Follis, and Humphreys found the development of anemia in 2 riboflavin-deficient pigs, which survived a long time. A moderate impairment in the rate of red cell and hemoglobin regeneration in the rat as a result of riboflavin deficiency has been demonstrated. Unmistakable anemia has been reported in monkeys. Upon administration of riboflavin, there is a definite increase in the hemoglobin, red cell, and white cell counts in the blood. There is no true evidence that riboflavin deficiency in man results in anemia. Myelin degeneration of the peripheral nerves and posterior columns of the spinal cord occurs in riboflavin-deficient dogs. It was thought that this vitamin might play a role in the etiology of subacute combined degeneration of the cord. That riboflavin is not the extrinsic factor has been conclusively demonstrated. Klein and Kohn have shown that the synthesis of flavinadenine dinucleotide from riboflavin takes place in human blood cells both in vitro and in vivo. It seems possible that this enzyme may be related to erythropoiesis or hemoglobin synthesis. It is known that d-amino acids are deaminized by an enzyme which contains the flavinadenine nucleotide, and Spector *et al.* have suggested that this vitamin may be concerned in the metabolism and arrangement of the amino acids of globin.

B. Nicotinic acid. Handler and Featherston demonstrated that the parenteral administration of physiological saline solution to dogs with acute black tongue resulted in alleviation of the existing hemoconcentration and was associated with the appearance of severe anemia. This responded immediately to the administration of nicotinic acid or nicotina-

mide. Histological examination of the tissues of 1 dog was made and revealed hemosiderosis of the spleen. Erythropoiesis appeared to have stopped at the erythroblast level. These authors postulated that since immature nucleated erythrocytes respire they probably use pyridine nucleotides in this respiration. As the supply of nicotinic acid diminishes, anemia develops because of the lack of cozymase in the earliest stages of cell development. Nutritional panmyelophthisis in rats has been reported as being prevented by nicotinic acid. The association of anemia with pellagra has long been known. This has been reported as varying in from 44 to 84 per cent of the cases. There is no evidence that the anemia associated with pellagra is due to nicotinic acid deficiency. Proof that such an anemia exists in man is lacking. Gastric achlorhydria occurs in approximately 80 per cent of the patients with pellagra.

C. Pyridoxine. The development of severe anemia has been adequately demonstrated to result from pyridoxine deficiency in dogs and swine. A mild anemia develops in pyridoxine-deficient chicks and in this species, the anemia is accompanied by a decreased clotting time, hyperprothrombinemia, and small spleens. Morphologically, the anemia in dogs and swine is microcytic and slightly hypochromic. It is severe in both species, and develops in other species within 2 months. The bone marrow in pyridoxine-deficient swine is hyperplastic. Following therapy with crystalline pyridoxine the marrow becomes normoblastic. Hemosiderosis of the spleen, liver, and bone marrow has been reported in swine. Following therapy the hemosiderosis of the liver and bone marrow disappears and that in the splenic pulp diminishes. Ataxia and convulsions have been reported in both dogs and swine, and, pathologically, the nervous system shows interesting changes. Degeneration takes place in the peripheral nerves, spinal ganglia, posterior roots, and the dorsal funiculi of the spinal cord. It would seem that pyridoxine, like the antipernicious anemia substance and copper, is essential to the integrity of both the nervous and hematopoietic systems. There is no evidence for the presence of a hemolytic element in pyridoxine-deficiency anemia. Elevated plasma iron levels in dogs were reported by Fouts *et al.* The serum iron increase has been studied in detail in swine and begins at about the fourth week of deficiency. Combined iron and pyridoxine deficiency results in an abnormally low serum iron level and in this combined deficiency hemosiderosis of the tissues is prevented. It would seem that the ferremia of pyridoxine deficiency is caused by continued retention of iron at a time when its utilization for hemoglobin synthesis is at a minimum. The possibility exists that the absorption of iron is increased in pyridoxine deficiency. Ninety-five per cent of the increased iron in the serum is in a nondialyzable, ferric state. Copper, unlike iron, is not mobilized in the blood of the severely anemic animal. There is no evidence to date that pyridoxine is directly concerned with the synthesis or metabolism of the porphyrins.

It has been shown that a relationship exists between pyridoxine and tryptophan metabolism. Since a deficiency of either pyridoxine or tryptophan gives rise to anemia, the question arises as to whether the two substances combine to form a third which is essential to blood formation. This is not the case. In swine, combined pyridoxine and iron deficiency results in a greater anemia than does either deficiency alone.

Pyridoxine has never been conclusively demonstrated to be essential to human nutrition. Pyridoxine-deficiency anemia resembles pernicious anemia in several respects. In both conditions there is an increase in serum iron, hemosiderosis of the tissues, hyperplastic bone marrow, and neurological lesions. That they are not the same is evidenced by a microcytosis in one and a macrocytosis in the other.

D. Lactobacillus casei factors. The various new factors described as having growth activity for the Lactobacillus casei and related organisms are many. Recently considerable clinical interest has developed in this group of substances because of the demonstration of the effectiveness of the synthetic Lactobacillus casei factor in various macrocytic anemias in relapse.

The value of folic acid (pteroylglutamic acid) in various types of macrocytic anemia in relapse has now been adequately demonstrated and repeatedly confirmed. Spies *et al.* observed a reticulocyte response and an increase in the red cell count in patients with macrocytic anemia in relapse. The drug was given orally to 4 patients in a dose of from 100 to 150 mgm. daily, and parenterally to 5 patients in a dose of from 20 to 50 mgm. Moore, Bierbaum, Welch and Wright noted clinical and hematologic remissions in 2 patients with Addisonian pernicious anemia following the daily oral administration for 10 days of 30 mgm. and 100 mgm. of the synthetic material, respectively. The response was excellent. Observations on the effectiveness of synthetic folic acid in the treatment of Addisonian pernicious anemia have now been confirmed many times. A daily dose of from 5 to 10 mgm., either orally or parenterally, will often produce a maximal response. Synthetic folic acid has been found to be effective in alleviating the hematologic as well as many of the other manifestations of sprue. The administration of from 15 to 200 mgm. daily is followed by a reticulocytosis and rise in the leucocytes, platelets, red count, hemoglobin, and volume of packed red cells to normal. The glossitis disappears in 3 or 4 days, after which there is rapid regeneration of the papillae. There is an improved sense of well being, an improvement in appetite, and a decided gain in body weight. Synthetic folic acid has been found to be effective in the treatment of nontropical nutritional macrocytic anemia of infancy with magaloblastic bone marrow, macrocytic anemia of pregnancy, macrocytic anemia associated with alcoholic cirrhosis of the liver, and macrocytic anemia associated with carcinoma of the stomach. No response to folic acid has been observed in cases of aplastic anemia, leukemia, or iron deficiency anemia. Folic acid has not been of value in

correcting the leucopenia of influenza, or the panhematopenia of myelophthisic and idiopathic states. It does not prevent the development of agranulocytosis in a patient receiving thiouracil.

Spies and coworkers have administered large doses (from 4 to 12 gm.) of thymin to 10 patients with Addisonian pernicious anemia. The clinical and hematological improvement was found to be similar to that which follows the administration of folic acid to such patients. The authors speculate that perhaps folic acid acts as an enzyme or coenzyme in the synthesis of thymin or a thyminlike compound. This naturally leads to questions as to the identity of the extrinsic factor, the intrinsic factor, and the antipernicious anemia substance in liver as postulated by Castle. It can be stated that the folic acid is probably not the extrinsic factor alone since it acts orally in the absence of normal human gastric juice and is effective parenterally.

E. Extrinsic factors. It has now been 17 years since Castle first presented evidence concerning a dietary factor which when incubated with a factor in normal human gastric juice formed a substance effective in the treatment of pernicious anemia. Beef muscle, yeast, wheat germ, milk, purified casein, liver, eggs, and rice polishings have been shown to contain significant amounts of the factor. The active factor can be removed from beef muscles by repeated extractions with dilute acetic acid or by extraction with from 70 to 80 per cent alcohol. It is water soluble, thermostabile, resistant to alkalinization, readily soluble in from 70 to 80 per cent alcohol, but is rapidly destroyed in 95 per cent alcohol. The active substance is ultrafiltrable and cannot be extracted from an 80 per cent alcoholic solution with ether. Following saturation of an alcoholic extract of beef muscle with ammonium sulfate the activity is found in the precipitate. The existence of an anemia due to a deficiency of Castle's extrinsic factor has been clearly demonstrated by Moore, Vilter, Minnich, and Spies. These workers have described the occurrence of macrocytic anemia in 56 patients who had existed for years on diets inadequate in animal protein and in the vitamin B complex. Most of the subjects had at one time shown clinical evidence of pellagra, riboflavinosis, or beriberi. The most striking clinical manifestations were weakness, pallor, glossitis, skin changes, and intermittent or persistent diarrhea. The anemia was cytologically indistinguishable from true Addisonian pernicious anemia, and the bone marrow was the same in the two conditions. Following the administration of an 80 per cent alcoholic extract of beef muscle a reticulocytosis developed and after prolonged administration the erythrocytes increased in number. All of the patients responded promptly to the parenteral injection of highly purified liver extracts. Studies on the pathogenesis of the anemia indicated that it was probably caused by a dietary deficiency of extrinsic factor associated in many, but not all, instances with poor absorption from the intestinal tract. The anemia, leucopenia, and thrombocytopenia all respond rapidly to pteroylglutamic (folic) acid therapy. The occurrence of macrocytic anemia of nutritional origin in India has been reported.

F. Ascorbic acid. It has been conclusively shown that the scorbutic state in guinea pigs as well as in human beings is frequently accompanied by anemia. The nature of this is in dispute.

This has been demonstrated in guinea pigs and the addition of ascorbic acid to a scorbutigenic diet prevents the development of the anemia.

The frequent occurrence of anemia in human scurvy has been reported by many authors. The red cells have been reported as being macrocytic, normocytic, and microcytic or hypochromic. The exact causal relationship still remains to be established and the literature is confusing.

AMINO ACIDS

Because of the difficulty in preparing a diet deficient in a single amino acid, only a few experiments of such a nature have been conducted. These included deficiencies of tryptophan, lysine, and phenylanine.

Rats fed a diet abnormally low in protein but adequate in all other respects develop anemia which responds to protein therapy.

The minimal molecular weight of hemoglobin has been shown to be about 16,700 and studies of the osmotic pressure and of the sedimentation constant have shown that the true molecular weight of anhydrous hemoglobin is close to 66,600, which indicates that hemoglobin is composed of four globin units.

No single amino acid appears to be more important than the others in hemoglobin synthesis.

For some time it has been known that tryptophan accelerates recovery and causes a prompt reduction in the reticulocytosis seen in anemia caused by phenylhydrazine. By acid hydrolysis of casein it has been possible to prepare a protein which is almost totally deficient in tryptophan. By this means the anemias as a consequence of deficiency have been studied. The results have not been conclusive.

Since a lack of either tryptophan or of pyridoxine leads to the development of anemia and since there is a disturbance of tryptophan metabolism in pyridoxine deficiency, the question arises whether pyridoxine anemia may be due to a lack of properly metabolized tryptophan. If this were true the two anemias should be similar but they are quite different. It is known that deaminization of casein destroys the entire content of lysine, about half of the histidine and a portion of the tyrosine. Hogan and Ritchie reported that rats maintained on deaminized casein develop anemia and splenomegaly. When casein was added to the deaminized casein ration the anemia failed to develop.

MINERALS

Iron. That iron is a constituent of the hemoglobin molecule and that a deficiency of iron gives rise to an anemia are both well established.

1. Availability. Dietary iron is of two types, organic and inorganic. The organic iron is present

principally in the form of iron porphyrin compounds. The ability of inorganic iron salts to cure iron deficiency anemia has been well demonstrated in many different species. On the other hand, it has been shown that organically bound iron is very poorly utilized when given orally. Organic iron, if it is to become available, must be converted to an ionizable form. In the case of hematin it has been shown that less than 25 per cent has been utilized, and this utilization appears to be dependent upon the amount of decomposition by intestinal bacteria. It would seem that the body's need for iron can be entirely satisfied by inorganic iron compounds.

2. Absorption. Iron is absorbed chiefly in the duodenum, but the stomach and the whole of the small intestine may take part under certain circumstances. It is doubtful if this occurs in the colon. It is absorbed by the tips of the villi of parts of the duodenum and from there is passed into the portal circulation and is carried to the liver.

a. Type of iron. It is generally believed that iron is absorbed in the soluble, ionizable, ultrafiltrable, ferrous form. The absorption of ferric compounds is generally less than that of ferrous compounds and is dependent on the capacity of the intestinal contents to reduce them. Organically bound iron is very poorly absorbed. Using the radioactive iron technique, it has been demonstrated in two different laboratories that human subjects absorb ferrous iron more efficiently than ferric iron. There is a species difference, however, and this may account for the disagreement between clinical and animal investigations.

b. Amount of iron. The height of the serum iron increase is directly proportional to the amount given up to that point at which intestinal irritation is great enough to interfere materially with intestinal motility.

c. Gastric acidity. The free gastric hydrochloric acid performs two functions: (1) reducing, ionizing, and dissolving the iron, and (2) delaying the formation of insoluble and undissociated iron compounds which may occur above *p*H 5. For these reasons any factors which cause increased alkalinity diminish iron absorption.

d. Conditions in the duodenum. The *p*H of the duodenal contents likewise affects the ionization and solubility of the iron compounds. The presence of certain reducing substances in the diet aids the absorption of iron. Liver extract is such a substance. The reducing properties of ascorbic acid are well known.

e. Calcium/potassium ratio and vitamin D. There is ample evidence that excess calcium in the diet inhibits iron assimilation and causes a mild anemia. Furthermore, all investigators are agreed that iron utilization is affected by the calcium/potassium ratio in the diet but there is disagreement as to whether a high or low ratio is favorable.

f. Selective absorption. There is considerable disagreement concerning this factor.

g. Other factors. There is suggestive evidence that pyridoxine may regulate iron absorption.

3. Transportation. There is now ample experimental evidence that there is a fraction of iron in the plasma which is in a nonhemoglobinous form. The significant fact concerning plasma iron is that it has been demonstrated to function as transport iron. It is interesting that transportation and utilization are very rapid processes. The normal range for plasma iron in human beings has been shown to be about from 0.050 to 0.180 mgm. per cent. The plasma iron level is affected by the rate of absorption of iron, the balance between that going to and from the tissues, and the equilibrium between the amount used for hemoglobin formation and that coming from hemoglobin catabolism. In general, in iron deficiency states it is uniformly low. Under conditions of decreased red cell formation, it tends to be high. When the bone marrow is unusually active the plasma iron is low. In hemolytic states the plasma iron level is dependent upon the equilibrium between the iron released by hemolysis of red cells and the rate of uptake by the bone marrow.

Barkan has described a third form of blood iron, constituting 5 to 10 per cent of the total blood iron, which he termed the "leicht abspaltbare Bluteisen" fraction. This was so named because it was easily freed from its lightly bound state in the erythrocytes and plasma by acidification with weak acids.

4. Storage of iron. Although the literature on this phase of iron metabolism is very extensive the storage of iron is poorly understood. The immobile fraction of body iron is made up of parenchyma iron and the iron in myohemoglobin. This constitutes about 23 per cent of the total body iron. Parenchyma iron is probably held tightly by the cells in such forms as cytochrome, catalase, peroxidase, and other cellular enzymes and is essential to the life of these cells. Myoglobin has been shown to be very similar to hemoglobin in respect to the absorption, iron content, and elimination by way of bile pigments, but may be differentiated by means of a specific precipitin reaction.

In the dog, Whipple and his coworkers concluded that the liver, spleen, and bone marrow are the principal sites of storage iron. Fifty to 70 per cent of the iron injected intravenously can be shown to be stored in the liver and spleen. The liver contains the main bulk of the iron stored and is considered the most important organ in the conservation and utilization of iron in the body. The turnover in the liver is exceedingly rapid if there is a demand for the element for blood formation. However, the spleen contains the highest reserve stores of iron per 100 gm. of fresh tissue. The iron content of the rib bone marrow runs parallel with that of the spleen.

Little is known concerning the chemical nature of the stored iron. Approximately 60 per cent of the iron in thoroughly perfused liver is in protein combination, in so far as it is removable from solution by precipitation with trichloracetic acid. It has been shown that 43 to 60 per cent of the iron in perfused adult rat liver reacts directly with bipyridine in the presence of a reducing agent and must, therefore, be

in some form of chemical combination other than that of the iron in hematin. About 60 per cent of this non-hematin fraction appears in the trichloracetic acid precipitate. The total iron in a trichloracetic acid filtrate reacts directly with potassium cyanate in acid solution after oxidation with hydrogen peroxide and this fraction accounts for about 40 per cent of the nonhematin iron. About 50 per cent of the total iron in the trichloracetic acid filtrate is precipitated along the organic substances by normal lead acetate. The digestion of fetal calves' livers, adult rats' livers, and muscle tissue, and beef spleen by pepsin at about pH_2 produces a five-fold increase in the iron content of the trichloracetic acid filtrate.

There is an appalling lack of knowledge concerning hemosiderin. It is recognized that it is the iron-containing portion of hemoglobin which rests in the cells of most tissues but especially is it found in the spleen, liver, and kidney following the destruction of erythrocytes. Hemosiderin probably represents some stage or side reaction in the disintegration of hemoglobin into bile pigment but the exact nature of the reactions involved is not understood. There is little doubt that it functions as storage iron, for the granules are abundant following repeated injections of ferric chloride and disappear when the demands of the body for iron are great.

5. Anemia of iron deficiency. The anemia of iron deficiency and its response to iron are well recognized. A hypochromic, microcytic anemia is characteristic of iron deficiency and has been described in different species. In the advanced stages marked anisocytosis and poikilocytosis of the red cells are present. The Price-Jones curves in severe cases show a marked shift to the left with a broad base. In the absence of iron, hemoglobin cannot be synthesized and there is a maturation arrest at the normoblastic stage. The bone marrow is hyperplastic and shows a predominance of the more mature nucleated red blood cells, principally the polychromatic normoblasts. There is no evidence that there is an increased rate of destruction of red cells. Porphyrin metabolism has been inadequately studied in iron deficiency. The normal erythrocyte protoporphyrin ranged between 20 and 45 gamma per 100 c.c. of erythrocytes. It has been demonstrated that the serum iron level is low in iron-deficiency anemias of varied etiology.

6. Excretion. It has long been claimed that iron is excreted by three routes: urine, bile, and the large intestine. It is now agreed that only a minimal amount of iron is excreted in the urine. It has been shown that the urinary excretion of iron is rather constant in the same individual and that it is not related to iron intake. There is evidence that significant amounts of iron are eliminated in the bile under certain circumstances. Under conditions of increased blood destruction the elimination of biliary iron may increase tenfold and parallels the increased output of bile pigment, but even then only 3 per cent of the released iron is eliminated in the bile. It would seem that the body controls the iron stores by controlling the absorption rather than its elimination and that once iron gains entrance into the body it remains there.

B. Copper. It has now been demonstrated many times in several different species that copper is needed in addition to iron in order either to prevent or to cure the anemia.

In the treatment of nutritional anemia in infants it has often been demonstrated that when iron therapy is combined with copper therapy the rate of hemoglobin formation is more rapid than when the anemia is treated with iron alone. The livers of anemic infants have revealed a lower copper content than the livers of nonanemic controls. There is little evidence to indicate that iron alone is as effective as combined iron and copper therapy in infants.

The value of copper in the treatment of hypochromic microcytic anemia in adults is controversial. In general, the consensus of most hematologists is that the adult patients with hypochromic microcytic anemia, in the absence of infections, malignancy, and continued hemorrhage, will respond satisfactorily and rapidly to iron medication. In nutritional anemia in infants the rate of hemoglobin formation is accelerated when copper is given in addition to iron. In adults supplemental copper therapy may be of value in a few cases. Most cases will respond if adequate doses of iron are given.

The absorption and excretion of copper in man has been little studied. The daily requirement of copper for adults is from 2 to 2.5 mgm. It has been estimated that the adult body contains between 100 and 150 mgm. of copper. During embryonic life copper becomes concentrated in the liver and reaches a maximum concentration at term. There is then a sharp decline after the second month. The copper content of the liver has been noted to be increased in Mediterranean anemia, hemochromatosis, cirrhosis of the liver, acute yellow atrophy of the liver, tuberculosis, and carcinoma. It is now agreed that the range for whole blood copper in normal adult males is approximately from 90 to 150 micrograms per cent, while that for normal adult females is approximately from 100 to 160 micrograms per cent. Copper is distributed approximately equally between the cells and the serum.

Many investigators have reported the presence of increased blood copper during pregnancy. Sachs and his group have made studies on whole blood copper as well as iron at various ages. In all the conditions studied there has been an inverse relationship between the copper and iron content. As the iron falls the copper content tends to rise. Hypercupremia is the usual response to hypoferremia.

Elevated serum copper values have been reported in pregnancy and in infections accompanied by anemia. In both of these conditions there is a low serum iron. The serum copper content is subject to diurnal variations but is not affected by menstruation.

7. The function of copper. The precise manner in which copper is related to the formation of red cells is not understood. It is not a constituent of the hemoglobin molecule. Since the administration of

copper to anemic rats is followed by a rise in the erythrocyte count without a rise in hemoglobin, it has been postulated that copper is essential for stroma formation of the cell or for the release of erythrocytes from the bone marrow rather than for hemoglobinogenesis. When iron is fed to iron and copper deficient animals the total iron content of the liver and spleen increases in proportion to the amount of iron fed. Thus in the absence of copper, iron is absorbed and stored normally. If copper is then fed to these animals in the place of iron, hemoglobin formation takes place and the iron content of the liver and tissue is reduced to a level of that found in severely anemic animals. From this it has been concluded and accepted that copper is essential for the mobilization of iron from the tissues and for its conversion into hemoglobin; or, stated in another manner, copper acts as a "catalyst" for the formation of inorganic iron into hemoglobin.

There are numerous other recognized functions of copper. It has been shown that copper is essential for the activity of at least 3 enzymes. The oxidation of crystalline glutathione is accelerated in the presence of small amounts of copper. The catalytic effect of copper on the oxidation of cysteine as well as ascorbic acid has been reported. Glycolysis is known to be activated by copper and accelerated in anemia.

C. Cobalt. The role of cobalt in erythropoiesis is unique. A deficiency results in anemia. The administration of small amounts to normal animals produces erythrocytosis, whereas the administration of large amounts depresses erythropoiesis. The enzootic occurrence of cobalt deficiency has been reported from several regions of the world. Anemia is present and is often severe. The anemia is either normocytic or microcytic, and usually hypochromic. Blood smears reveal anisocytosis and poikilocytosis. There is a hypoplasia of erythrogenic tissue in the bone marrow, hemosiderosis of the tissues and a reduction in reticulocytes in the blood. An experimental anemia due to cobalt deficiency has not been produced in either rats or dogs. There is no substantial or convincing evidence that cobalt is needed by human beings for normal erythropoiesis. The administration of small amounts of cobalt to normal rats, dogs, guinea pigs, frogs, mice, rabbits, chickens, pigs, and ducks produces a marked polycythemia which is accompanied by a reticulocytosis, hyperplasia of the bone marrow, and an increased erythropoietic activity in the spleen and liver. Larger doses of cobalt inhibit erythropoiesis. The metabolism of cobalt is unlike that of iron. The excretion of cobalt once it is absorbed is exceedingly rapid and is principally through the kidneys. LEROY J. KLEINSASSER, M.D.

SURGICAL TECHNIQUE

OPERATIVE SURGERY AND TECHNIQUE; POSTOPERATIVE TREATMENT

Livingston, K. E.: Extremity Refrigeration without Tourniquet Ligation in Cases of Acute Arterial Deficit. *Ann. Surg.*, 1947, 125: 431.

The author discusses the experimental studies carried out by Allen in 1938 and 1939, when he demonstrated that intact limbs can survive complete ischemia for significant periods if absolutely cooled. In 1941 these observations were applied clinically to amputation under tourniquet ligation and refrigeration. This method now has real value in preparing for, and reducing the risk of, amputation in the presence of advancing gangrene and toxic absorption, or in cases of massive trauma to the limb. Limbs to be amputated by this method are ligated by tourniquet and cooled to levels of 2 to 8 degrees centigrade above freezing. Changes which are probably irreversible occur in the tissues. These are the combined result of cooling and of complete ischemia produced by the tourniquet. On the basis of present clinical experience, tourniquet ligation and refrigeration are appropriate only as preparation and cannot be safely employed when survival of the limb is anticipated. There is evidence clinically and experimentally that the more severe changes may be attributable to tourniquet ischemia rather than to cooling. The author believes it is therefore possible that refrigeration without tourniquet might be successfully employed in some cases of acute vascular deficit in which survival of the limb is anticipated.

The author cites a few clinical reports of refrigeration without tourniquet followed by amputation, but no pathological studies were made of the amputated extremities so no conclusions could be drawn. He cites one other case in which pathological studies were made and this revealed that the distal circulation of leg and foot was remarkably preserved. However, the conclusions in this case were pessimistic.

The author then cites his own experience. Following an acute and severe vascular accident secondary to traumatic aneurysm of the popliteal artery, cooling of the distal extremity was carried out for 28 days prior to amputation. During the interval of observation, changes which were assumed by all observers to have been irreversible, regressed, and the appearance of the foot strikingly improved. Following amputation there was gross and microscopic evidence that revascularization was taking place in the cooled tissues and that the nutrition of the deep muscle tissues and weight-bearing skin and subcutaneous tissue of the foot had been well maintained. These studies did not indicate that the smaller circulation in the cooled areas had been extensively shut down by vasoconstriction due to cold. The author was impressed by the wealth of small patent vessels in all tissues, and also by the active recanalization processes in the thrombosed segments of major arteries.

It is believed that further clinical experience would be valuable in confirming or modifying these views, and suggested that in the future more adequate cooling be used, and that it be combined with alcohol block or lumbar sympathetic ganglionectomy because vasospasm may be a significant factor.

G. Albin Liva, M.D.

Shaffer, J. O.: A Method of Rapid Transfusion into the Femoral Vessels in Patients without Adequate Peripheral Superficial Veins. *Surgery*, 1947, 21: 659.

When rapid transfusion is required in a patient whose superficial veins are thrombosed or difficult to enter, the author advocates that the femoral vessels be used. If the femoral artery has a good pulsation, the common femoral vein is usually patent and should be used. A 20 gauge needle, 2½ inches long, with a short bevel, is inserted just medial to the arterial pulsation and just below the inguinal ligament, perpendicular to the skin. As the needle is advanced to a depth of 2 to 3½ cm., dark venous blood will appear in the syringe. Aspiration of 5 to 10 c.c. of blood, reinjection, and reaspiration insures that the needle point is well placed in the lumen of the vein. When a patient is in such profound shock that the pulsation of the femoral artery cannot be felt, the femoral vein is usually collapsed and unsuitable for venipuncture. The artery should then be used, the puncture being made just distal to the inguinal ligament and at the midpoint between the anterior superior iliac spine and the pubic tubercle.

When the needle has been well placed it should be secured in position with three small Kelly forceps. These grasp the needle as close to the skin as possible, each forceps being placed 120° away from the other two. The three forceps should then be taped firmly to the skin of the thigh and abdomen. In most instances it is also advisable to restrain the patient's leg.

Blood, plasma, or fluids may be allowed to drip, or may be forced into the vessel under pressure. When the infusion has been discontinued, momentary pressure over the site of puncture is sufficient to prevent hematoma formation.

B. F. Lounsbury, M.D.

Goinard, P., Ferrand, J., and Tardieu, P.: Postoperative Complications in Alcoholics (Sur certains accidents post-opératoires graves des éthyliques). *Lyon chir.*, 1947, 42: 56.

A group of characteristic complications occur in chronic alcoholic patients following operation. They usually begin about the first postoperative day and consist of fever, progressive agitation, delirium

tremens, and oliguria. In many instances death ensues. Eight cases are cited to illustrate the typical history of this syndrome in chronic alcoholics who underwent a gastrectomy for ulcer.

The authors have instituted a definite regimen to control and prevent this syndrome. Treatment consists of large doses of strychnine which are apparently well tolerated by these individuals. The dosage varies from 12 to 36 mgm. daily, according to the clinical response and the severity of the disease; it is given every 2 hours and usually continued for 3 days, sometimes 5 or 6. In addition, bevetin, liver extract, and intravenous fluids are given. Sedation, in general, to control the agitation has proved unsatisfactory, although of the common hypnotics used, chloral hydrate seemed best.

This particular group of postoperative complications can be avoided by proper preoperative management. One week of complete preoperative rest with complete alcoholic abstinence, and a high carbohydrate consumption are recommended. Strychnine is given in daily doses of from 6 to 18 mgm. for 5 to 7 days accompanied by bevetin, hepatic extracts, and small doses of insulin.

Certain precautions should be taken during operation. Because of the unstable circulatory system in chronic alcoholics, the use of general anesthesia and administration of intravenous fluids are hazardous. Postoperative treatment is based on establishing a proper fluid balance and giving large doses of strychnine. Vitamin K should be used if any tendency toward bleeding is present. The authors suggest hepatic insufficiency as the basis for this syndrome.

C. Frederick Kittle, M.D.

ANTISEPTIC SURGERY; TREATMENT OF WOUNDS AND INFECTIONS

Vaughan, J., Thomson, M., and Dyson, M.: The Blood Picture and Plasma Protein Level following Injury. *J. Path. Bact.*, Lond., 1946, 58: 749.

The authors describe their observations on the blood picture, serum bilirubin, plasma proteins, and urinary urobilin in a series of 14 patients following various types of injury. These were divided into three groups: (1) injuries other than those due to enemy action; (2) industrial injuries in which superficial burns were associated with fractures, and (3) injuries due to enemy action.

The findings irrespective of the character of the injuries, revealed the following:

During the first week there was a fall in the hemoglobin and red cells, and either a fall in the plasma proteins or an initial low level. In regard to the differential proteins, albumin decreased but this was accompanied by a rise in globulin and fibrinogen. A rise in the reticulocytes preceded a rise in hemoglobin and was associated with a rise in the red cells and plasma proteins. The serum bilirubin was higher in the first few days, although within normal limits, and the urobilinogen in the urine was noticeable in several cases.

The authors then discuss these findings and their causation, concluding with the suggestion that the anemia occurring during the first 10 days after injury is not due to blood loss or hemolysis but to a disturbance of hemoglobin synthesis dependent upon disordered liver function. In view of their findings in these patients they stress the importance of a high protein intake in all surgical cases.

G. Albin Liva, M.D.

Corcoran, A. C., and Page, Irvine H.: Crush Syndrome. *J. Am. M. Ass.*, 1947, 134: 436.

Traumatic shock is thought of as an acute state from which no threatening conditions persist. Crush syndrome was rediscovered, named, and studied on a wider scale during the London blitz.

Typically, the syndrome is initiated by crushing of a limb or occlusion of its arterial supply for several hours. Release from debris or restoration of the blood flow is followed by swelling with wheal formation at the sites of compression. The limb becomes hard, paralyzed, and anesthetic. Loss of plasma into the area of injury causes hemoconcentration. Shock may supervene and be relieved by transfusion. Urine passed during the first 24 hours is colored red or brown with myoglobin, contains albumin, and shows many brown and black granular pigment casts. The urinary output and specific gravity thereafter diminish. The patient passes into restless delirium with thirst and vomiting. Arterial pressure and the concentration of serum potassium are increased. Azotemia rises until about the sixth day, when death suddenly occurs in about two-thirds of the cases. The volume of urine of those who are to recover increases about this time, and their renal function is slowly restored in the succeeding months.

The exact mechanism of hemoglobinuric nephrosis is not established. There is compelling evidence which associates it with urinary acidity.

Others believe that renal injury in the crush syndrome is a consequence of prolonged arterial hypotension with renal ischemia and anoxia.

The mechanism of crush syndrome can be visualized as follows:

Vasoconstrictive renal ischemia occurs with the onset of shock or even of injury. The urine is acid and small in volume. The muscle cells are fragmented, so that when the circulation is restored through the crushed areas myoglobin diffuses into the blood, whence it is filtered into the renal tubules. Thus, the conditions of pigmentary precipitation (aciduria, oliguria) are encountered, while the kidney is further damaged by the lack of blood flow. It has been demonstrated that hemoglobin precipitation in the renal tubules is facilitated by prior injury, whether from ischemia or injection of a nephrotoxin (tartrate). However, it is not clear from these experiments whether the factor responsible was cellular injury as such, or oliguria resulting therefrom. In either case, the conditions of precipitation are present in crush syndrome.

The major renal lesion in crash syndrome is epithelial. Renal epithelium is sensitive to a variety of toxins.

Treatment is directed toward the underlying mechanisms.

The primary problem in renal damage is the renal ischemia. This is due to vasoconstriction.

Thus, the basic preventive measures in crush syndrome are: (1) pressure bandaging of the injured limb, (2) rapid treatment of shock with restoration of the blood pressure, (3) provision of adequate fluid, (4) provision of a diuretic, and (5) the administration of an alkali. HARRY W. FINK, M.D.

Brush, B. E., Lam, C. R., and Ponka, J. L.: Wound Healing Studies on Several Substances Recommended for the Treatment of Burns. *Surgery*, 1947, 21: 662.

Although marked advances have recently been made in the therapy of burns there is still a considerable vogue for the use of ointments and other topical applications. Few of the agents employed have been subjected to critical examination of their effect on wound healing.

The authors have investigated a group of substances commonly employed in the treatment of burns, as well as some experimental ointments submitted by the Subcommittee on Burns and Surgical Infections of the Committee on Medical Research. The substances tested were: tannic acid solution, tannic acid in tragacanth jelly, commercial tannic acid jelly (Amertan), petrolatum gauze, two kinds of carbowax ointment, a mineral oil and aluminum monostearate preparation, proflavine dihydrochloride, biodyne ointment, and hydrosulfosol solution. Each substance was tested on 12 guinea pigs. The animal's abdomen was aseptically prepared, and two circular cutaneous defects were made, one on each side of the midline. The wound on the left was used as the test wound and the other as a control. The wounds were outlined on sterile cellophane, and the test material was then applied to the test wound. Sterile dressings were applied firmly to the wounds, and were changed every 2 days until the wounds had both healed. At each change of dressings new cellophane records of the size of the wound were made.

None of the substances studied showed an appreciable accelerating effect on wound healing. All the tannic acid compounds showed definite inhibition of wound healing. Petrolatum gauze had no effect. Both types of carbowax ointment delayed wound healing slightly. Proflavine dihydrochloride and hydrosulfosol were mildly inhibitory. Biodyne ointment was also slightly inhibitory. The stearate grease-treated wounds healed in the same time as the controls. B. F. LOUNSBURY, M.D.

Colebrook, L., Duncan, J. M., and Butterfield, W. J. H.: Added Infections in Burns. *Lancet*, Lond., 1947, 1: 321.

This article is a report of further study of infection acquired apart from dressing of the wound. The investigation overlaps that reported by Bourdillon and Colebrook (1946). It deals with the 12 months from August 1, 1945 to August 1, 1946, during which period was recorded the time when the wound was dressed, the type of cover (perfect or imperfect) on the wound, and exposure of the wound (if any) since the last dressing.

Daily records were kept showing the order in which patients were dressed, the clinical condition, and the bacteriological flora of the burned areas at the time of dressing.

Organisms used as indicators for added infection are the hemolytic streptococcus, the Pseudomonas pyocyanea, and the Bacillus proteus because of ease of identification and because these 3 are more often associated with delayed healing and unsuccessful grafting operations.

In most cases the burn was covered with tulle gras, then dry sterile gauze, then absorbent cotton, and, last, crepe bandages. A light shell of plaster-of-Paris is often applied in the cases of children.

The term "added infection" is used to denote the growth of 1 of the 3 indicator organisms from burned areas which had been free from such infection on admission, such infection having been obtained during the hospital stay.

Included in the authors' records in this article were records of whether the burned areas were incompletely covered and whether they were liable to infection from without.

In the period covered by this article no dressings of fresh burns were carried out in the open wards. All first dressings were done in rooms which were not supplied with dust-free air. All except 107 of the subsequent 1,419 dressings were done in a dust-free atmosphere.

The data summary showed that of the 220 patients with burns free from all indicator organisms on admission, 29 (13.2%) acquired one or more during their hospital stay. In 28 of these the infection probably was acquired in the ward during the interval of dressing.

It is shown that the incidence of added infection was closely related to success or failure in keeping the burned areas adequately covered with dressings. It also seemed obvious to the authors that the added infection had arisen by transfer of infective material from sources outside of the patient.

Clouds of pathogens are liberated during bed changes and when dressings are applied. The clothing of doctors, nurses, and visitors (especially those with throat infections), flies, drinking utensils, bedpans, thermometers, toys, and materials of occupational therapy are other sources of infection.

The following procedures seem to the authors of chief importance in the prevention of added infection in the wards:

1. Maintenance of perfect cover. The recommended dressing is to cover the burned area with sterile gauze, then wool (¾ to 1 inch thick), and, finally, crepe bandage. This should be supported by adhesive, and in an active child by a light plaster-of-

Paris cast over the crepe bandage. Daily careful examinations of the bandage during ward rounds are essential.

2. Restraint of bacterial growth on the burns, and elimination of reservoirs of infection. For routine dressing the authors have used for the past 3 years a cream containing penicillin and sulfathiazole in a bland base (Clark *et al.*, 1943), with very satisfactory results. After the first application of this cream, the dressings are left undisturbed for from 7 to 12 days, and subsequent dressings for from 5 to 7 days. If hemolytic streptococci were found on culture, a course of 4 or 5 applications of penicillin cream at 2 day intervals was instituted with excellent results in eliminating reservoirs of this organism.

3. Rapid repair of epithelial skin covering. It is difficult to keep large granulating surfaces free from all added infections for many weeks. The longer the burned area is kept uncovered with epithelium the more fibrous tissue is formed beneath it; this often leads to serious dysfunction. For this reason, grafting as early as possible is recommended and should be repeated without delay. Repeated regrafting with stored skin or with small grafts should be a routine dressing procedure.

4. Antidust measures and the elimination of flies. Oiling of blankets after laundering (Harwood *et al.*, 1944), and of floors (Andrewes *et al.*, 1940), are 2 simple methods advocated. Frequent spraying of D.D.T. in white spirit plus screening will take care of flies.

5. Segregation of infected cases in cubicles. Ideal burn units would be single units for half of the bed accommodations, and for the rest bed rooms to accommodate 2 to 4 patients.

6. Routine purification of the air of wards. Whatever methods are used, frequent cleaning of the air of wards with burn patients is a desirable goal.

The incidence of added infection in burns which were found to be imperfectly covered when redressed was 10 times as high as that of the burns which had a perfect cover during the interval between dressings.

The problem of controlling added infections of burns with the Staphylococcus aureus remains untouched, but the authors state that the elimination of these infections is likely to present great difficulties because of the great prevalence of this organism.

DAVID H. REID, M.D.

Ritter, A., and Pletscher, A.: The Treatment of Wounds with Sulfonamides. A Clinical and Experimental Histological Report. (Wundbehandlung mit Sulfonamiden. Klinischer und experimentell-histologischer Beitrag). *J. internat. chir.*, Brux., 1946, 6: 61.

The authors studied the effects of the various sulfonamides on clean and infected wounds in guinea pigs. The sulfonamides used were cibazol, ilkosin, haptocil, and irgamid, which are the European equivalents of sulfanilamide, sulfathiazole, sulfapyridine, and sulfadiazine. They studied, histologically, the tissue in which the sulfa drugs had been introduced 1, 12, and 24 hours later and from 2 to 14 days later. They found that the degenerative changes in the subcutaneous tissue and the muscle were somewhat more marked following the use of sulfonamides than in the controls, but also found that the connective tissue regeneration was greater at the same time. They found that edema and cellular infiltrations were less marked in infected cases following the chemotherapeutic treatment, but that the wounds did not heal as readily as the infected ones even though the connective tissue regeneration was more pronounced. They state that the slight delay in wound healing was usually caused by too much sulfonamide powder or crystal in the wound and around the tract of the wound.

They conclude from their surgical experience and their experimental work that the local application of sulfonamide in infected or traumatic wounds is definitely beneficial and increases tissue reaction and connective tissue regeneration. They warn against using too much drug, and emphasize that the use of sulfonamide drugs should never take the place of primary surgical treatment of the wound.

GEORGE PERRET, M.D.

Domagk, Gerhard: Present Day Status of Chemotherapy of Bacterial Infections by Sulfonamides (Der derzeitige Stand der Chemotherapie bakterieller Infektionen mit den Sulfonamiden). *Deut. med. Wschr.*, 1947, 72: 6, 71.

The bacteriostatic effect of sulfonamides is dependent on different factors. One of these is the chemical constitution. Those compounds in which the sulfonamide group (SO_2NH_2) is in a p-position to the amino- group are more effective than others. The bacteriostatic effect is not diminished when the hydrogen atoms in the NH_2 group as well as in the SO_2NH_2 group are substituted. Of special interest are experiments with certain anaerobic organisms, like the Bacillus welchii. In vitro these bacilli are very little influenced by the most used sulfonamides like prontosil, sulfapyridin, and sulfathiazole, but they show a specific sensitivity to the German product marfanil $H_2N-H_2C\bigcirc SO_2NH$ and its derivatives in which the amino group is not linked directly to the phenol ring but to a methyl group in p-position to the sulfonamide group.

The simplest method to test the influence of a compound on different species of bacteria is to add the drug to ordinary laboratory media, preferably agar or blood agar, and to inoculate the bacillus on this medium. The degree of the effect depends on 3 factors: the species and strain of the organism, the compound used, and the culture medium. The bacteriostatic effect varies considerably with the same compound in different media. In vitro, bacteriostasis occurs in concentrations between 1 to 10,000 and 1 to 80,000.

It would, however, be wrong to draw too far-reaching conclusions from laboratory experiments.

Many compounds, e.g., the original prontosil, which are quite successful clinically and in animal experiments have only a poor bacteriostatic effect in vitro. The reasons for this difference are manifold. In the first place, some drugs are changed chemically after their introduction into the organism into substances which are more effective than the original product. Furthermore, synergism between the sulfa compounds and the phagocytic action of leucocytes, histiocytes, and other elements of the reticuloendothelial system is necessary to develop an optimal action on the bacilli. Phagocytosis of the organisms which have been paralyzed by the sulfonamide compounds is essential for a full therapeutic effect. It has been shown that bacteria were phagocytized in the presence of sulfonamides if they had not been attacked by phagocytes previous to the sulfonamide treatment. This change is due to the bacteriostatic effect of the drug, not to any stimulation of the leucocytes.

In animal experiments with phlegmonous cellulitis caused by highly virulent streptococci, the author showed that in untreated animals no walling off of the focus occurred and the phlegmon spread without any resistance. Very soon after onset of the sulfa treatment, however, more and more leucocytes could be observed to be invading the focus, phagocytizing the streptococci, and walling off the entire area.

Although the author agrees that the action of sulfa compounds is mainly bacteriostatic, he believes that some bactericidal effect takes place too, especially under conditions unfavorable to the growth of the organisms, such as poor media and increase of temperature to 39 or 40° C. This observation is further supported by the fact that patients with high fever show a quicker and more intensive response to sulfa treatment than those with low grade fever or normal temperatures.

During the war, infections with the different bacilli of gas gangrene were rampant in Germany, not only in war wounds but also complicating appendicitis, cholangitis, perforating peptic ulcer, and other abdominal pathology. In these cases, topical and systemic application of the sulfonamides gave excellent results. Whereas before the sulfonamide period the mortality in perforating appendicitis was as high as 14 per cent, it dropped to 1 per cent under sulfa treatment.

As to wounds, especially battle wounds which were exposed to infection, the author suggests routine treatment (topical and systemic) with a mixture of 2 sulfa compounds, one effective against aerobic, the other against anaerobic bacilli.

The indications, the technique of application, and the dosage are discussed in detail, as well as the different compounds which have been used in Germany during the war. (Since the author uses only proprietary names in his article, it could not be ascertained in most cases what compounds were used (marfanil, marbadal, debenal). The German eleudron is identical with sulfathiazole.

The author stresses the importance of topical application in surgical cases.

WERNER M. SOLMITZ, M.D.

Shaffer, J. O.: Intra-Arterial Penicillin in the Surgical Treatment of Infections of the Extremities. *Surgery*, 1947, 21: 692.

The author describes his method of injecting penicillin intra-arterially in the treatment of infections of the extremities. The intra-arterial route of administration of drugs was apparently first utilized by Heddaus, in 1914, when he injected antitetanic serum into the carotid. Subsequently, numerous other workers have employed a great variety of therapeutic agents, seeking to obtain a high local concentration within certain tissues by injection of the drug directly into the artery supplying those tissues. In infections of the extremities, often large areas are involved, and the penicillin penetration becomes a problem because of impaired blood supply or because the infection lies within bony or fascial pockets. When penicillin is injected intra-arterially the dilution remains minimal, and the blood pressure forces the concentrated drug into the tissues.

The author makes use of a blood pressure cuff applied to the extremity distal to the point of injection and inflated to a subdiastolic pressure. This prevents the return of venous blood and yet permits the continued arterial pressure to distribute the drug. An ingenious use of radioactive phosphorus, traced to its ultimate destination by Geiger counters, demonstrated that this method of injection gave a higher concentration of injected material for a longer period than did intravenous injection or intra-arterial injection without a cuff or with a cuff inflated to supradiastolic pressure. The actual injection is done with a 20 c.c. syringe attached to a 20 gauge needle 2½ inches long. The point of maximum pulsation of the femoral artery just below the inguinal ligament (or the brachial at the elbow or the distal portion of the axillary, for the upper extremity) is palpated, and the artery is steadied with the index and middle fingers of the left hand. The needle is than inserted perpendicular to the skin, between the steadying fingers. A pulsating bright red stream showing in the syringe indicates that the needle point is within the arterial lumen. When the injection has been completed the site is subjected to temporary digital pressure to prevent hematoma formation. The dosage used by the author has been 50,000 Oxford units of penicillin in 10 c.c. of normal saline. One or two daily doses should be given until optimal results have been obtained.

Types of infections successfully treated by the author in his series of 40 patients included diabetes, arteriosclerosis, osteomyelitis, suppurative joints, infected ulcerations, infected operative incisions, and various types of gangrene. He observed no hematoma in any of his cases as a result of the arterial puncture.

The only contraindications to the procedure are phlebothromboses and infections of the skin overly-

ing the proposed site of injection. When procaine is given along with the penicillin, local anesthesia is obtained and simple surgical procedures may be performed. B. F. LOUNSBURY, M.D.

Bowie, J. H., and Borcar, M. D.: Continuous Injection of Penicillin: the Secunderabad Apparatus. *Lancet*, Lond., 1947, 1: 477.

The authors—a penicillin research team (India Command) at Secunderabad—cite their experiences in treating war wounds, chiefly unhealed compound fractures of the femur. Because of the difficulties experienced in these cases when penicillin was administered by three-hourly injections or by the ordinary Army saline-giving sets, they were prompted to develop a method for the continuous administration in small volume. They concluded that penicillin should be injected continuously in as small a volume as possible, and that rubber tubing be avoided. Since the amount of sodium penicillin commonly administered in 24 hours is readily soluble in 2 milliliters of water, it was believed that a syringe should be attached to the patient and some means evolved to depress the piston slowly over a period of hours.

The authors give a detailed explanation of this apparatus which is fitted with needles which are suitable for subcutaneous, intramuscular, or intravenous use.

The authors describe the advantages of the apparatus as follows: (1) an absolutely constant injection ensuring a maximum constant blood penicillin level at a minimal expenditure of the drug; (2) possibility of blockage in the needle during injection is eliminated; (3) supervision is unnecessary except when set up on the patient and when recharged at 24 hour intervals; (4) the small volume (2 ml.) in which the penicillin is injected reduces proportionately (a) pain and local edema, and (b) deterioration of the penicillin at room temperature; (5) the patient is not confined to bed but to the length of his cable, and may leave the ward by separating the cable at an appropriate point; (6) booster doses can be given at any time; (7) according to the number of cable adapters fitted to the distribution box on the motor, any number of patients in a ward can be treated simultaneously; (8) there is no contact with rubber tubing; and (9) it may be used in research on the action of other drugs.

The authors observed that blood-penicillin levels became constant throughout the day and night after a "building up" period, directly proportional to the dose and inversely proportional to the patient's weight. They found that for every 0.02 unit of penicillin required in the serum, a dose of 25,000 units a day per 140 pounds of body weight must be given. From this datum the dose required to obtain the required blood-penicillin level in any patient can be calculated by proportion. The dose of penicillin required for any particular patient may be estimated if the resistance of the invading pathogen and the patient's body weight are known.

G. ALBIN LIVA, M.D.

ANESTHESIA

Hughes, E. S. R.: Refrigeration Anesthesia. *Brit. M. J.*, 1947, 1: 761.

Twenty-five cases of amputation under refrigeration anesthesia are reported with details of the individual cases and the technique employed. This method of anesthesia was reserved for "bad risk" cases. Progressive gangrene of the foot complicated by severe pain or infection was most frequently the cause for amputation. The underlying constitutional pathology was "atherosclerosis" or "diabetes mellitus."

The technique of refrigeration used is simple. No costly apparatus is necessary. A wooden box lined with galvanized iron sheeting is filled with chipped ice and this is kept at room temperature overnight to allow the sharp edges to be melted away. The tourniquet is not an essential requirement at any stage of the procedure and may be dispensed with entirely, but its employment is advisable. The period of time for which the limb is refrigerated depends on the relation of the local lesion to the general condition of the patient; if the former is the cause of depression of the latter, then by cooling the lesion to 5°C., at which level metabolism is minimal, it becomes physiologically disconnected from the body. If the patient has severe pain and toxemia the affected area of the limb is refrigerated for several days without a tourniquet; several hours before operation the refrigerated area is extended to just above tourniquet level. The minimum time for which a limb may be safely refrigerated before operation varies from 2 to 3 hours. Amputation is carried out as in cases with the usual form of anesthesia. There is no primary shock despite the fact that the patient remains fully conscious throughout surgery.

Complications were occasionally secondary shock, bronchopneumonia, and, most frequently, infection.

Experimental and practical evidence is convincing that refrigeration anesthesia is a sure means of excluding a constitutional depressant, and a useful measure in certain "bad risk" cases.

JOHN E. KARABIN, M.D.

Saklad, Meyer; Dwyer, Clement S.; Kronenberg, Sanford; Neves, Edmund; and Sorkin, Morris: Intraspinal Segmental Anesthesia; A Preliminary Report. *Anesthesiology*, 1947, 8: 270.

A technique of obtaining a segmental distribution of spinal anesthesia is presented. A limited number of spinal nerve roots are bathed by an anesthetic solution within the subarachnoid space. This is accomplished by injecting a solution of pontocaine hydrochloride in a dilution of 1 to 1000 through a fine catheter which has been passed cephalad within the subarachnoid space for a distance of from 15 to 25 cm. The total dose of pontocaine is a small fraction of that ordinarily required for spinal anesthesia.

This preliminary report includes the authors' first 24 cases of intraspinal segmental anesthesia for abdominal surgery. In 20 cases the anesthesia was sat-

isfactory and in 4 cases there was technical failure because of faulty placement of the catheter.

The dilute solution of pontocaine hydrochloride in spinal fluid may be considered to be nearly isotonic, isobaric, and isohydrionic. Local toxic effects and neurologic sequelae are, therefore, less likely to result. The accurate deposition of such a weak solution of anesthetic agent within the subarachnoid space reduces the hazard of respiratory paralysis.

Persistence of motor power in the lower extremities may result in a more efficient return flow of blood to the heart and may have a beneficial effect on the systemic circulation during anesthesia. Maintenance of muscle tone in the legs may result in a decreased incidence of phlebothrombosis, and postoperative urinary disturbances may be less common.

MARY FRANCES POE, M.D.

Dripps, Robert D.; and Sergent, Warren F.: Use of a New Curarizing Agent, Dihydro-Beta-Erythroidine, for the Production of Muscular Relaxation during Anesthesia and Surgery. *Anesthesiology*, 1947, 8: 241.

This preliminary report concerns the intravenous administration of a relatively new curarizing agent, dihydro-beta-erythroidine, to 215 patients receiving general anesthesia. No attempt was made to select cases. Cyclopropane, ethyl ether, sodium pentothal, and nitrous oxide were the anesthetic agents employed.

Dihydro-beta-erythroidine decreased or abolished the conduction of impulses from nerve to skeletal muscle in a curariform fashion. Muscles were affected in the same sequence as with curare. Satisfactory surgical relaxation was recorded in 96 per cent of the cases. The drug seems indistinguishable in this regard from curare. The decrease in respiratory minute volume was accomplished almost entirely by a diminution in depth per breath. Respiratory rate remained relatively unchanged, or increased. A paralytic effect was exerted on the striated laryngeal muscles.

Hypotension occurred in 86 per cent of the patients. The amount of blood pressure decrease was related in part at least to the amount of drug administered. The impression was gained that the degree of hypotension produced was also related to the level of anesthesia. The fall in blood pressure was a transient phenomenon as a rule, lasting from 5 to 10 minutes. It is thought the reaction is related primarily to depression of the medullary vasoconstrictor center or to paralysis of the sympathetic ganglia with diminution of the arteriolar tone.

The circulatory depressant action described suggests the possibility of direct depression of the medullary vasomotor center. There is also other evidence in man and animals which indicates that curare and the erythrine alkaloids depress the central nervous system.

The initial dose which the authors recommend is between 50 and 75 mgm. if ethyl ether anesthesia is employed, and between 75 and 100 mgm. if the anesthetic agent is cyclopropane. The major complication of intravenous administration of dihydro-beta-erythroidine was the hypotension.

MARY FRANCES POE, M.D.

PHYSICOCHEMICAL METHODS IN SURGERY

ROENTGENOLOGY

Hodgson, H. K. Graham: Cholesteatomas of the Temporal Bone. *Brit. J. Radiol.*, 1947, 20: 202.

The formation of a cholesteatoma requires two conditions: (1) a chronic low grade infection, and (2) a diploic, or poorly pneumatized, mastoid.

The lesion is associated with a longstanding foul aural discharge. The normal mucosa of the middle ear is eventually replaced by epidermal cells, either from the epidermis of the external auditory canal through the ruptured drum, or by cellular metaplasia. The continuously desquamating cells collect in a slowly enlarging mass in the epitympanic recess, the auditus, and the antrum. The surrounding bone is gradually eroded by the pressure of the expanding mass. A thin protective ring of sclerosed bone is often seen around the mass, but when there is a marked sclerosis of the surrounding bone this ring may be partly or entirely concealed.

As the cholesteatoma erodes more and more bone, perforation of the containing cavities will occur. The most common types of perforation occur through the tegmen tympani into the middle fossa of the skull, into the external auditory canal, and into the attic with resulting fistula.

The roentgen diagnosis of cholesteatoma may be difficult. Usually, an oval or rounded area of bone destruction is encountered in the immediate neighborhood of the mastoid antrum or attic. This area is not so transradiant as a solitary air cell of the same size would be and not infrequently is surrounded wholly or partially by a thin line of sclerosed bone. Perforation of the containing walls is visualized as an actual gap in the bone or, more usually, as an area of local rarefaction. Fistulas, when visible, appear as funnel shaped defects in the labyrinthine bone close to the apex of the external canal of the labyrinth.

The differential diagnosis of cholesteatoma from mastoid abscess is based on its location in the immediate neighborhood of the antrum and attic, and its association in the great majority of cases with an acellular or poorly pneumatized mastoid.

T. Leucutia, M.D.

Pendergrass, E. P., and Kirsh, D.: Roentgen Manifestations in the Skull of a Metastatic Carotid Body Tumor (Paraganglioma), of Meningioma, and of Mucocele. *Am. J. Roentg.*, 1947, 57: 417.

The authors present in detail 3 cases of osteolytic lesions of the skull. The underlying lesions were a metastatic carotid body tumor, a meningioma, and a mucocele. All 3 of these patients had certain similar physical findings, such as exophthalmos.

Carotid body tumors have been known by many terms. The confusing terminology is undoubtedly the result of the presence in the carotid body of vascular, neural, and fibrous tissue. The symptoms produced by these tumors are those of pressure on the neighboring structures, and consist of hoarseness, cough, dysphonia, dilatation or constriction of the pupil with or without narrowing of the palpebral fissure, nausea, vomiting, tachycardia, abdominal pain, constipation (vagus pressure), tinnitus aureum, headache, local pain, or pain in the arm or shoulder, dyspnea, or dysphagia. The tumor is usually slow growing. The diagnostic triad which helps in the identification consists of (a) location at the crotch of the carotid, (b) a sense of pulsation in the tumor due to its vascularity, and (c) mobility of the tumor from side to side, but not up and down. One of the cases presented had metastases to the bones, liver, lungs, and the iliac vein. The metastases to the left frontal bone with involvement of the orbital roof produced the exophthalmos.

The meningioma in this group was classified as a malignant fibroblastic meningioma, a variety of tumor which is encountered relatively infrequently. The exophthalmos was produced by involvement of the right orbit, frontotemporal, and sphenoidal regions of the skull.

Mucoceles represent a relatively uncommon condition. They are most common in the frontal and ethmoidal sinuses. They are characterized by long duration, insidious development, lack of insistent symptoms, and distention of the cavities. The exophthalmos in the case of mucocele described was produced by the tumor mass which involved the left orbit, left frontal sinus, left maxillary sinus, and left ethmoidal sinus.

Osteolytic lesions of the calvarium are diagnostic problems which can only be answered after careful correlation of the clinical, roentgenological, and pathological aspects of the case.

Frank L. Hussey, M.D.

Murphy, J. P., and Arana, Roman: The Pneumoencephalogram of Cerebellar Atrophy. *Am. J. Roentg.*, 1947, 57: 545.

The authors stress the importance of the roentgenographic appearance of the cerebellum in pneumoencephalograms. Detailed inspection of the encephalographic appearance of the contents of the posterior fossa is of greatest interest when degenerative disease or maldevelopment of the cerebellum is suspected, and objective confirmation of clinical impressions may be obtained thereby. In addition, air study of the brain, particularly in lateral views with the occipital region of the head superior, may reveal unexpected cerebellar disease. The pneumoencephalograms thereby provide a means of substantiating (but not necessarily rejecting) the diagnosis of cerebellar atrophy, and may bring to attention unsuspected degeneration of the cerebellum as a primary process or complication of other known disease of the

nervous system. Structural abnormalities of the cerebellum may or may not be associated with cerebellar symptomatology, but, if the abnormalities are of sufficient magnitude, they may be visualized by pneumoencephalography.

Anatomical alterations of the cerebellum may be divided into 2 categories—the atrophies and the malformations. Both of these for the purpose of orientation and clarity may be further subdivided.

Fifteen cases in which there was pneumoencephalographic evidence of cerebellar atrophy or degeneration of hypoplasia were presented. Cerebellar involvement in these patients was "primary" (?), the result of pontomedullary nuclear degeneration, cerebral atrophy, trauma, associated with Friedreich's disease, or the cerebellum was hypoplastic in a condition of cerebral dysgenesis.

Cerebellar atrophy may appear as enlargement of the cisterna magna and fourth ventricle, as widening and deepening of interfolial sulci and fissures, or as a combination of these abnormalities. Scalloping and deep fissuring of the surfaces of the hemispheres and nodulation of the vermis are especially evident in cerebellar degeneration of the parenchymatous cortical or olivopontocerebellar types and in Friedreich's disease. Increase in size of the cisterna magna and fourth ventricle as compared with the normal is a feature of cerebellar hypoplasia. This may be related to initiation of the pathological process at the start of the developmental period or to the immature form of the cerebellum in infancy.

FRANK L. HUSSEY, M.D.

Greening, R. R., and Menville, L. J.: Roentgen Findings in Torulosis. Report of 4 Cases. *Radiology*, 1947, 48: 381.

Torulosis is a rare disease affecting the central nervous system and lungs. Rarely are the lungs the only site involved; in the authors' study there were 4 proved cases among 537,135 admissions in the last 10 years.

Torulosis also is known as European blastomycosis and is caused by a yeastlike organism, Torula histolytica. It is found in grass, insects, bees' nests, pickle brine, canned butter, and milk. Nonpathogenic strains are found in the throat, skin, and gastrointestinal tract of normal people.

The organisms are mainly histolytic, so that many of the inflammatory cells following ingestion of the yeastlike bodies are destroyed by them.

The central nervous system is mainly affected; this was true in 83 of 107 recorded cases. Lung involvement is rare; there were only 20 cases in which the lungs and nervous system were involved and only 4 in which the lungs alone were involved.

In the latter group of cases, the source of entrance of the organism was via the respiratory tract. Nodular, gelatinous masses are formed. These tend to coalesce and form abscesses. They spread via the lymph and blood stream.

Clinically, the disease is characterized by symptoms of meningeal irritation, fever, increase in intracranial pressure, diplopia, nystagmus, and hemiplegia.

Roentgen findings in the lungs which may suggest Torula are: predilection of the bases, involvement well circumscribed, and patchy areas of homogeneous consolidation with a small amount of reaction around the edges. Consolidations tend to coalesce with or without cavities. As the lesions heal, small amounts of fibrosis remain. Enlarged lymph nodes may be suggestive of a Boeck's sarcoid or pneumoconiosis.

Of the 4 patients with pulmonary Torula, 3 had associated involvement of the nervous system. If the lungs alone are affected, the disease is not as overwhelming. One patient is alive 39 months after the onset of symptoms, 2 patients died in 4 months, and the patient with pulmonary disease only is alive 18 months after the onset of the disease.

MAURICE D. SACHS, M.D.

Rakofsky, Max; and Satinsky, Victor P.: Roentgenological Aspects of Battle Injuries of the Chest. *Am. J. Roentg.*, 1947, 57: 583.

The authors emphasize, by means of representative cases among 200 cases of thoracic injuries observed at a base hospital, the roentgenological aspects of the conditions encountered when foreigh bodies are present. The foreign bodies traumatizing the chest consisted of bullets, shell fragments, projectiles, and missiles of various type. Their course was often bizarre. Vital information concerning foreign bodies as to character and localization can be obtained from roentgenoscopy.

Injury to the bony thorax is a common occurrence. This may vary from simple fracture to severe comminutions.

Pulmonary contusions are invariably manifested by localized or diffuse areas of interstitial or intra-alveolar hemorrhage. Roentgenologically, pulmonary contusion is represented by one or more areas of opacity of bizarre distribution and irregular outline.

Disruption of the pleurae in association with laceration of the parietes frequently results in subcutaneous emphysema. Roentgenologically, subcutaneous emphysema appears as streaklike areas of increased radiolucency in the soft tissues of the chest wall.

Practically all cases of penetrating wounds of the chest suffer pneumothorax, air being admitted from the exterior. In injuries of the chest such as fractured ribs, pneumothorax may also occur from lacerations of the visceral pleura and pulmonary parenchyma.

Pneumothorax displays a characteristic roentgen feature: a brilliantly illuminated hemithorax devoid of lung markings, obscured medially by the collapsed lung and producing mild displacement of the cardiac shadow to the opposite side.

Hemothorax is a natural sequel to perforating chest wounds and is invariably found as a hemopneumothorax. Roentgenologically, it is identified by the signs of massive, moderate, or slight opacity of the pulmonary field with a curved fluid level, and

with or without mediastinal shift to the opposite side. In the presence of associated pneumothorax there is a horizontal fluid level.

Loculated or encapsulated hemothorax is characterized by fibrous pleural bands enclosing an accumulation of blood, with or without air, at various levels in the pleural cavity. On the roentgenogram loculated hemothorax may be represented as various sized and irregularly distributed fluid levels.

Clotted hemothorax occurs in from 4 to 6 per cent of cases with hemothorax. Roentgenologically, clotted hemothorax may assume a variety of appearances. There may be mottling, multiple fluid levels, densely thickened pleurae, or signs of traction. These may appear alone or in combinations.

Empyema from pleural sepsis in battle casualties is given variously from 21.9 per cent in penetrating, and 11.3 per cent in nonpenetrating wounds to 25 and 33 per cent, respectively.

Atelectasis is commonly found in association with thoracic wounds subsequent to compression phenomena, injury to the bronchial tree, and a mucus plug occurring as a postoperative complication. Its appearance on the roentgenogram varies from streak to platelike densities to massive opacities. In the latter instance, there is retraction of the mediastinum to the same side, narrowing of the rib interspaces, and elevation of the diaphragm.

Bronchopleural fistulas occur infrequently in thoracic wounds and generally follow in the wake of empyema, sinus tract, or surgery.

Blast or concussion injuries to the lungs following waves of compressed air brought to bear upon the thorax occur in about 2 or 3 per cent of the cases. The roentgenological features of blast injury are streaklike densities involving the pulmonary fields, usually most prominent at the bases.

Transdiaphragmatic injuries occur in 10 per cent of battle injuries of the chest and have a 25 to 40 per cent mortality rate. Hepatopleural fistulas may be present or become manifest after admission. In penetrating wounds of the diaphragm immediate or delayed herniation of the abdominal organs may follow. On the roentgenogram, diaphragmatic hernia must be differentiated chiefly from empyema cavity, loculated pneumothorax, interlobar fibrosis, lung abscess, eventration of the diaphragm, pulmonary cyst, and giant emphysematous blebs. Subphrenic abscesses constitute an additional complication.

Penetrating missiles occasionally leave roentgenologic evidence of their passage through lung tissue in the form of "tracks." FRANK L. HUSSEY, M.D.

Henny, G. C., Boone, B. R., and Chamberlain, W. E.: The Electrokymograph for Recording Heart Motion. Improved Type. *Am. J. Roentg.*, 1947, 57: 409.

The authors report and describe improvement of the electrokymograph for recording the heart motion, with use of the roentgenoscope.

The apparatus employs a roentgen ray pick-up device which, when properly placed over the roentgenoscopic cardiac silhouette, translates the motion of this silhouette border into a varying electrical current. The current is recorded with the aid of a standard electrocardiographic machine.

They also describe the construction of a carotid pulse recorder which is used to record the pulse in conjunction with the heart border motion.

FRANK L. HUSSEY, M.D.

Dexter, Lewis: Venous Catheterization of the Heart. Results, Interpretations, and Value. *Radiology*, 1947, 48: 451.

The author presents the findings in representative types of congenital heart disease. In the presence of an auricular septal defect, blood usually flows from the left auricle to the right auricle. The venous catheter is helpful in the recognition of this defect by two methods. The catheter may be introduced through the defect, or arterial blood may be found in the right auricle.

An uncomplicated defect in the interventricular septum results in the shunting of arterial blood from the left ventricle to the right ventricle. Its recognition by venous catheterization depends on the finding of a significantly higher content of blood in the right ventricle than in the right auricle.

The tetralogy of Fallot consists of pulmonic stenosis, an interventricular septal defect, over-riding or dextroposition of the aorta, and right ventricular hypertrophy. Because of the pulmonic stenosis, venous blood enters the pulmonary artery with difficulty and some is shunted through the septal defect and into the aorta. The patients are, therefore, cyanotic, and suffer mainly from a deficient blood flow through the lungs. The venous catheter may follow one of two courses. It may pass through the stenosed pulmonary valve into the pulmonary artery, or it may pass through the interventricular septal defect and go directly into the over-riding aorta.

Patent ductus arteriosus is a vascular anastomosis between the aorta and pulmonary artery which during fetal life serves to bypass the lungs. Its persistence after birth is deleterious, because of the ease with which bacterial vegetations become implanted and also because of the circulatory strain thrown on the left ventricle. Since the flow of blood after birth is from the aorta, where the pressure is high, to the pulmonary artery, where it is low, there is no cyanosis and the lesion is detectable on venous catheterization by the finding of arterial blood in the pulmonary artery or, in other words, blood with a higher oxygen content in the pulmonary artery than in the right ventricle.

Venous catheterization promises to be an important aid in preoperative diagnosis of congenital cardiac defects. FRANK L. HUSSEY, M.D.

Merner, T. B., and Stenstrom, K. W.: Roentgen Therapy in Hodgkin's Disease. *Radiology*, 1947, 48: 355.

A comprehensive study of Hodgkin's disease is reported by the authors. The cases are divided into

two series, one series comprising 185 cases, proved histologically, the other, 53 cases in which Hodgkin's disease was found clinically, the biopsy specimens having been examined at other institutions. All patients were treated from 1926 through 1942 and were followed through December, 1945.

Many different titles have been given to diseases in the lymphoblastoma group. The most common title, and one which avoids confusion, is Hodgkin's disease. The etiology of Hodgkin's disease is still undetermined. Some authors have attributed it to a tubercle bacillus; others believe it may be due to a diphtheroid bacillus, brucella, a filtrable virus, or to a neoplasm.

The symptomatology and physical findings of Hodgkin's disease are variable. Sometimes the only complaint may be enlarged lymph nodes, generally in the cervical or axillary region, with systemic symptoms such as fever, weakness, anorexia, and loss of weight. A concomitant upper respiratory infection may be present, with a dry, hacking cough which is generally indicative of mediastinal involvement. Dyspnea, cyanosis, or dysphagia are frequently seen when mediastinal involvement is present. Backache may be due to enlarged retroperitoneal lymph nodes. Pruritus is due either to a lymphangitic infiltration in the skin or to enlarged lymph nodes.

The pathology of Hodgkin's disease is divided by most authorities into three groups: (1) the paragranuloma, which is benign; (2) the granuloma, which presents a serious prognosis; and (3) Hodgkin's sarcoma, which is highly malignant.

Hodgkin's disease is to be differentiated from leucemia, lymphosarcoma, and tuberculous adenitis. Its incidence in all races is equal, and it occurs more frequently in males (70%) than in females. In 27 per cent of cases, the disease develops during the third decade of life. In 61 per cent of cases the site of onset is in the peripheral lymph nodes, and in 10 per cent of cases, in the axillary lymph nodes. In 83 per cent of the authors' cases the cervical lymph nodes were involved.

Each case should be considered individually and no set routine of radiation therapy should be attempted. An average dose of 1,000 tissue roentgens should be given. In some instances as much as 2,000 roentgens may be delivered to the areas in which the condition is localized; in cases in which lesions have been present for quite some time, a much heavier dose is necessary. The authors believe it unwise to treat an area prophylactically, since it is impossible to determine the site of later tumefaction. Irradiation of the entire body has been carried out, but, in the opinion of the authors, total body irradiation in itself is not sufficient to check the progress of the condition, and it is their belief that it should be given in conjunction with localized therapy. Fifty to 75 roentgens in air should be administered in cases of enlarged mediastinal lymph nodes (not the usual 250 or 300 roentgens) to avoid edema of the bronchi with compression and respiratory embarrassment.

An analysis of the authors' cases reveals that, in general, the survival time of children was shorter than that of adults, the average survival being under 20 months. In the first series of 185 cases there was a 5 year survival rate of 21 per cent, and a 10 year survival rate of 8 per cent. The average duration of life was 33.1 months. MAURICE D. SACHS, M.D.

Warkany, J., and Schraffenberger, E.: Congenital Malformations Induced in Rats by Roentgen Rays. *Am. J. Roentg.*, 1947, 56: 455.

Roentgen rays have been used experimentally in rats to produce malformation, either by irradiating the sex gland of mature animals, or the pregnant female. In the first type, the germ plasm is injured and subsequent generations inbred are malformed. In the second type, the modifications are induced in the embryo which is often deformed at birth. The authors are concerned with the second type, and primarily with skeletal malformation.

Pregnant rats of the Spraque-Hawley strain were irradiated on the tenth, eleventh, twelfth, thirteenth, fourteenth, fifteenth, and sixteenth day of gestation with a single dose of from 190 to 1,120 roentgens.

Malformations were induced in rats on the tenth to sixteenth day of gestation. Higher doses produced deformities of the brain, eye, and the upper and lower jaw. The relationship of dose to deformity was in direct ratio. For example, on the fourteenth day of gestation the rats were given a single dose of 190 to 250 roentgens, with the result that the litter appeared normal except for minor deformities of the fingers and toes. A dosage of 890 to 950 roentgens produced severe external malformations with 22 out of 24 cleft palates.

Variations were observed in the same litter. This was attributed to different stages of development.

Skull defects were seen only in those cases in which the rats were irradiated on the tenth, twelfth, thirteenth and, in a few instances, fourteenth day of gestation. Angulation of the ribs was seen in those rats which were irradiated on the fifteenth and sixteenth day of gestation; cleft palate was particularly noted on the fifteenth day; the vertebral column was not affected.

Of the 622 young rats obtained from 144 mothers, 485 had skeletal deformities, primarily confined to the skull, cleft palate, short mandible, and angulation of the ribs, arms, and legs.

MAURICE D. SACHS, M.D.

MISCELLANEOUS

CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

Cohn, E. J.: The Separation of Blood into Fractions of Therapeutic Value. *Ann. Int. M.*, 1947, 26: 341.

This article is number 51 in the series, "Studies on Plasma Proteins," from the Harvard Medical School, Boston, Massachusetts, on products developed by the Department of Physical Chemistry from blood collected by the American Red Cross.

Medicine is concerned with understanding, in the interest of control, all of the component parts of the body and their functioning. The level of understanding, at any time, has reflected the new knowledge in the natural, as well as in the medical, sciences. The chemistry of the sixteenth and seventeenth centuries related to the blood largely through the concern of Boyle, Hooke, and Newton with the nature of the elements, especially the gases of the atmosphere. The need of air for life was recognized. Mayow noted the role of oxygen in the air in respiration, Hooke, the role of the lungs, Harvey, of the heart, Malpighi, the role of the capillaries, and Leeuwenhoek had noted the red blood corpuscles in the blood stream. The anatomical and physical advances in Italy and in England had by 1700 thus made possible some understanding of the mechanical bases of respiratory processes.

These observations were appraised and organized into a system of quantitative knowledge by Lavoisier in the eighteenth century, and expanded in exploration of the more complex organic molecules of natural systems by Liebig and Berzelius during the early part of the nineteenth century. These new tools led to Woehler's synthesis of urea in 1828. However, more than a century later the synthesis of the larger and more complex protein molecules composed of amino acids bound in peptide linkage had not been accomplished.

The first amino acid discovered was the cystine of cystine stones by Wollaston in 1810, but not recognized as a constituent of proteins until 80 years later. Until 1865 but 3 amino acids had been isolated from proteins.

The attack on the chemistry of the proteins was not resumed with equal vigor and talent until late in the nineteenth century. Knowledge of the laws governing natural systems developed more rapidly than knowledge of the nature of the substances. The observations by Poiseville on the laws of viscous flow and by Pfeffer and deVries on osmotic pressure played an important role in the development of physical chemistry, which—starting in 1878 when Van't Hoff applied the gas laws to solutions and Arrhenius the discrepant behavior of salts due to their electrolytic dissociation into ions—has made possible understanding of even such complex organic ions as the proteins.

The foundations for the present rich development, both in the theory and practice of protein chemistry, were laid by Sir William Hardy at the turn of this century. He correctly interpreted the movement of proteins in an electric field as due to their dissociation as electrolytes, and demonstrated that their electrophoretic mobilities could vary, not only in amount but also in direction, which demonstrated that proteins are amphoteric electrolytes. Thus it followed that proteins were in equilibrium with the other ions of the body, and although they bore positive electric charges in acid solution and negative electric charges in neutral and alkaline solutions, there would be a zone in which they bore no excess of positive or of negative charge and thus were in an isoelectric condition. Most of the proteins have been found isoelectric between p_H 4.5 and 7.5 and to be far less soluble in the neutral isoelectric than in the ionic condition.

In 1923 Debye developed the electrochemical theory of solutions. The method of purifying and crystallizing albumins in concentrated salt solutions was perfected by Sir Frederick Gowland Hopkins and S. P. L. Sorensen. Proteins may be precipitated not only by "salting out" but also by the addition of alcohols, acetone, or other water-miscible organic solvents to their solutions. Irreversible changes in

TABLE I.—INTERACTIONS OF BLOOD PROTEINS

Protein	Fraction	Interacting molecule	Origin of interacting molecule	Physiological function
Hemoglobin	Red Cells	Oxygen	Air	Respiration
Carbonic anhydrase	Red Cells	Carbon dioxide	Tissues	
Prothrombin	III-2	Thromboplastin	Tissues	Clot formation
Fibrinogen	I	Thrombin	Prothrombin	
γ-Globulins	II	Antigens		Immunity
	III-1			
Complement:	III		Viruses and Bacteria	
C'1	IV			
C'2				
Isoagglutinins	III-1		Red Cells	
Hypertensinogen	IV-4	Renin	Kidney	Blood Vessel constriction
Hypertensinase	Red Cells and Plasma	Hypertensin	Hypertensinogen	
β_1Lipoprotein	III-0	Estriol, Vitamin A		Lipid transport
α_1Lipoprotein	IV-1	Vitamin A		
Choline esterase	Red Cells	Choline esters		Ester hydrolysis
Serum esterase	IV-6	Choline esters*		
Phosphatase (Alkaline)	IV	Phosphoric acid Mono esters		
Plasminogen**	III-3	Proteins	Plasma	Protein hydrolysis
Iron Binding Serum Globulin	IV-7	Iron		Iron transport

*Hydrolyzes methyl butyrate. **Fibrinolytic enzyme precursor.

the labile protein molecule can generally be minimized if the temperature is maintained sufficiently low. Under these conditions denaturation was minimized. Neutral salts increased the solubility of the albumin under these conditions as they do the solubility of globulin in water.

SOLUBILITY OF THE PROTEINS IN ALCOHOL-WATER MIXTURES OF CONTROLLED *p*H IONIC STRENGTH AND TEMPERATURE

This investigation laid the foundation for the separation of plasma proteins that has been carried forward during this war.

The use of alcohol as a protein precipitant made possible protein fractionations at the low salt concentrations at which protein-salt interactions are maximum. The new conditions of fractionation in alcohol and water mixtures at low temperatures are essentially bacteriostatic and reduced the danger of pyogenic reactions. The choice of a *p*H close to the isoelectric point of the protein to be precipitated made unnecessary the use of high concentrations of alcohol.

The temperature was maintained close to the freezing point of the alcohol-water mixture at alcohol concentration less than 15 volumes per cent.

The ionic strength was reduced to any desired point following the initial precipitation of a protein fraction.

Among proteins with the same isoelectric points, differences in the influence of salt on their solubility are most important in achieving their separation.

THE SEPARATION OF PLASMA INTO FRACTIONS

The gross separations of the various cellular elements from the plasma is the first step in the dissection, first by mechanical and then by chemical means, of this complex blood.

The chemical method for plasma fractionation was devised to take advantage of differences in solubility which reflected differences in molecular size and electric charge, in nonpolar side chains, or in dissociated polar groups leading to different isoelectric points and electric moments.

The process that has been developed during this war yields six major proteins:

Fraction I contains most of the fibrinogen and the antihemolytic globulin.

Fraction II contains the Y globulin antibodies of proved value in the prophylaxis of measles and probably infectious hepatitis.

Fraction III-1 contains antibodies including those to typhoid O, and also the isoagglutinins including the anti-Rh antibodies.

Fraction III-2 contains prothrombin.

Fraction III-3 contains plasminogen.

Fraction III-0 is rich in lipoproteins and is the bearer of cholesterol, carotene, and vitamin A.

Fraction IV-1 is lipoprotein in nature.

Fraction IV-4 contains enzymes and hormones.

Fraction V contains the human serum albumin.

Fraction VI consists of a large amount of salts.

The fractionation of the plasma has made available albumins for use in shock and the specific globulins in measles, hemophilia, blood typing, and blood clotting; has separated many of the smaller molecules, and has demonstrated that they are not free in the blood stream but are in highly specific, more or less labile, combination with the larger proteins. DAVID H. REID, M.D

Mostofi, F. K., and Engleman, E.: Fatal Relapsing Febrile Nonsuppurative Panniculitis. *Arch. Path.*, Chic., 1947, 43: 417.

The authors described and reported in detail a case of nonsuppurative nodular panniculitis which showed the most widespread involvement of adipose tissue so far reported in the literature.

The patient was a 39 year old Filipino soldier who had recurrent fever of 7 months' duration, associated with leucopenia and, in the last 2 months of his illness, with cutaneous lesions that recurred and regressed without leaving scars. The cutaneous lesions showed a histologic picture compatible with the diagnosis of early nonsuppurative panniculitis. Nonsuppurative lesions of the fat cells in their early stages were also present in the epicardial, peripancreatic, periadrenal, perirenal, and mesenteric tissues. Hyperplasia of the reticuloendothelial system and of the bone marrow with definite retardation of development of granulocytes was also observed. There were foci of necrosis in the liver with portal cirrhosis and extensive fatty metamorphosis of the liver. No fat embolism of the lungs, evidence of suppuration or clinical evidence of renal disturbance, was noted.

The genesis of this disease remains obscure; no etiologic agent could be determined in the author's case. Disturbances of the metabolism of fat present an intriguing explanation which is entirely speculative and hypothetic. ROBERT TURELL, M.D.

Dargeon, Harold W.: The Diagnosis and Management of Neoplastic Diseases in Childhood. *Med. Clin. N. America*, 1947, 31: 498.

In neoplastic diseases of children the relationship between the growing tumor and the growing child is usually the basis on which clinical manifestations of the disease are recognized. Because of the peculiar tissue contents of such tumors as teratomas, as well as of the pineal, pituitary, thyroid, adrenal, ovarian, or testicular glands, slight to marked alterations in skeletal and somatic growth may occur. Diametrically, the onset of puberty may witness the malignant transformation of a melanoma. Consideration of an epiphyseal cartilage when a tumor is in the immediate vicinity is of importance.

In children as in adults the earliest treatment must follow the earliest possible diagnosis. Furthermore, it is preferable to consider all tumors as potentially, if not actually, incompatible with life, rather than to diagnose them as benign or malignant.

The following classification is of clinical satisfaction and indicates the tumors which the author discusses in a rather comprehensive, manner.

1. Cysts secondary to fetal structural defects
   a. Those resulting from failure of involution of normal fetal tracts, e.g., thyroglossal and bronchial cysts, Rathke's pouch cyst.
   b. Aberrant tissues, e.g., accessory thyroid gland.
   c. Cystic disease, e.g., polycystic kidney, and pulmonary, hepatic, or pancreatic cyst.
2. "True" tumors of embryonal or differentiated structure
   a. Teratomas, teratoid tumors, and dermoids
   b. Tumors of the following sites:
      (1) Nervous system-cranium, spinal cord, peripheral nerves, sympathetic system,
      (2) Eye and orbit
      (3) Bones—benign and malignant
      (4) Lymphatic and blood forming organs—leukemia, lymphosarcoma, and Hodgkin's disease
      (5) Genitourinary tract
      (6) Somatic structures, including the skin, fat, connective tissue, muscle, vessels, nerves, and synovia.

Other tumors such as those of the breast, gastrointestinal tract, and endocrine glands also occur but, because of their rarity during childhood, are not discussed.

The author suggests a complete examination in accordance with the following schedule: from birth to 1 year—monthly, from 1 year to 6 years—quarterly, from 6 years to 12 years—semiannually, and from 12 years to maturity—annually (to include chest ray and blood study).

DAVID H. LYNN, M.D.

Jönsson, G.: A New Method of Treating Capillary Hemangiomas. *Acta chir. scand.*, 1947, 95: 275.

Hemangiomas are benign tumors, made up almost exclusively of vascular tissue, which may be classified into two main groups: the capillary or telangiectatic type and the cavernous type. The latter consists of large irregularly shaped spaces, generally communicating with each other, and when most typical these tumors resemble normal erectile tissue.

Capillary hemangiomas are made up of a dense network of capillaries of a nearly uniform caliber with a sparse amount of interstitial tissue, and these tumors vary from pin-head size to large patches sometimes involving an entire extremity or even one-half the body. Their color ranges from light red to dark lilac, depending on the depth of the lesion below the surface, the density of the capillary bed, and the amount of cavernous tissue present. The skin of the face and the neck is most commonly involved. The tumors are of congenital origin, and once developed they seldom regress. Inflammation, ulceration, or thrombosis occasionally occurs.

Cavernous hemangiomas can be treated with irradiation, with very satisfactory results, particularly during the first year of life. Capillary hemangiomas, however, do not respond as well to irradiation. The numerous other methods of treatment in vogue, such as electrocautery, the application of carbon dioxide snow, and scarification tend to leave a conspicuous cicatrix. Surgical excision of the tumors is satisfactory, but often technically impossible owing to the wide extent of the capillary mass.

Jönsson describes 17 cases of capillary hemangioma treated by an exceedingly simple method which, as regards the final cosmetic result, he believes is quite satisfactory. Essentially his technique consists of destroying the capillaries in the surface layers of skin by abrasion while leaving the subcuticular tissues intact. The hemangioma is diffusely infiltrated with 1 per cent novocain, and is rubbed directly with sterilized sandpaper, taking care not to extend the rubbing beyond the tumor into normal skin, nor into the subcuticular tissues. Bleeding is profuse and pressure must be constantly applied during the procedure. All of the tumor may ordinarily be treated at one seance. Infection must be scrupulously avoided, and the author prefers sulfathiazole ointment dressings. Complete healing occurs in about 10 days.

All cases of hemangioma are not equally well suited for this treatment; the dark red or bluish tumors respond much better than do lesions of a lighter color. Size is of no consequence, but for a good result it seems necessary that the hemangioma can be emptied of blood by compression and stroking with the finger. Cavernous hemangiomas should not be treated by this method.

In a 2 year follow-up, 13 of the cases showed good or completely satisfactory cosmetic results, and 4 cases showed only moderate improvement. Before and after photographs of 4 cases are included.

WYANE CAMERON, M.D.

Muskat, D. A., and Norwich, I.: Amebic Granuloma of the Skin. *Brit. J. Surg.*, 1947, 34: 287.

Amebic granuloma of the skin, or amebiasis cutis, an uncommon lesion due to infection with the Endamoeba histolytica, appears in the literature because of its rarity and interesting pathological and clinical picture. The Endamoeba histolytica may, under certain conditions, invade the skin and cause extensive ulcerative granulomatous lesions. Blood stream invasion has never been reported. The lesions arise by direct continuity via the lymphatics from some focus such as a drainage tract from the liver, around a colostomy, or from the rectum.

An unusual case report of amebiasis cutis of the buttocks is presented. A painful ulcerating lesion of the buttocks and posterior rectal wall was biopsied and ameba were found in the excised tissue. Because of contamination by the feces a proximal colostomy was done. The patient responded miraculously to emetine hydrochloride. Prior to the diagnosis of amebic infection the ulcerating lesion did not respond to the usual measures employed in perianal lesions. It is suggested that any acute ulcerative perianal lesion not responding to usual chemotherapeutic methods, be given a therapeutic test by emetine hydrochloride biopsy and stool examination for the Endamoeba histolytica. The lesion is slightly raised with steep, at times undermined, edges and surrounded by an

area of induration showing all signs of inflammation. The floor of the ulcer is covered with sloughing granulation tissue and is extremely painful and tender.

JOHN E. KARABIN, M.D.

Macomber, W. B., and Paletta, F. X.: Malignant Tumors of the Skin in Military Personnel. *Plast. Reconstr. Surg.*, 1947, 2: 234.

Two hundred patients with malignant skin tumors were seen in a military hospital plastic service during a 3 year period. Seventy-eight per cent were in the second or third decades. The face was the site of the lesion in 92 per cent.

Three types of problems were presented: (1) reconstruction of a defect made in previous excision of the tumor; (2) removal of early malignant changes resulting from incompetent x-ray therapy; and (3) removal of tumors inadequately excised or which had received various forms of inadequate treatment.

The principles advocated include (1) wide excision of all lesions; (2) closure directly, by shifting of adjacent skin flaps or with skin grafts; (3) definitive reconstruction 6 months to 1 year after excision of large, highly malignant lesions (after sufficient time has elapsed to be sure there is no persistent tumor); and (4) multiple excision after application of a temporary skin graft, if the defect warrants this.

Examples of various types of lesions of the forehead, eyebrow, eyelid, cheek, nose, lip, buccal mucous membrane, and ear, with 26 photographs and 10 drawings are presented.

FRANK B. QUEEN, M.D.

Hieger, I., Henry, S. A., Ross, P., and Winternitz, J. G.: Symposium on Industrial Skin Cancer. *Brit. J. Radiol.*, 1947, 20: 145.

The mechanism of cancer production by carcinogenic hydrocarbons is completely unknown. The enormous variation in potency brought about by comparatively trivial changes in constitution suggests that a subtle and unidentified property within the molecule holds the now unknown key to carcinogenicity.

Illustrations of various sites and types of industrial skin cancer are presented, together with statistical data of its incidence, the exposure period, duration, and the results of treatment with roentgen rays.

FRANK B. QUEEN, M.D.

GENERAL BACTERIAL, PROTOZOAN, AND PARASITIC INFECTIONS

Hoffman, William S., and Volini, Italo F.: Studies in the Oral Administration of Penicillin. Assays of Various Preparations and the Determination of the Effective Therapeutic Dose. *Am. J. M. Sc.*, 1947, 213: 513.

The authors point out that it is an established fact that orally administered penicillin can produce therapeutic levels in spite of the fact that a portion of the penicillin is destroyed when it comes in contact with gastric acid. A number of oral preparations were assayed in this study to determine an effective dosage.

Estimations of plasma penicillin concentrations were made with the Bacillus subtilis serial dilution method of Randall, Price, and Welch as modified by Hickey. Since it has been alleged that the Bacillus subtilis method is of doubtful value because of the presence of inhibitors in many penicillin-free blood specimens, the authors took controls both from patients before the administration of penicillin, and from untreated control patients. The authors were convinced that with their use of this assay method, possibly because of their use of citrated plasma, false positives would not ruin their study.

Since there is no agreement as to what plasma penicillin levels achieve therapeutic effectiveness, the authors accepted the empirical and established finding that 20,000 units every 3 hours, when given intramuscularly, were effective in most acute infections responsive to penicillin. Such injections give plasma levels of 0.5 unit per cubic centimeter at ½ hour, 0.06 at 2½ hours, and 0.03 at 3 hours.

A large variety of penicillin preparations were used with and without diluents, antiacids, and buffers. On the whole, there was little difference in the statistical levels no matter which preparation was used. Crude penicillin alone in capsules produced almost the same values as did crude penicillin protected with pectin. Pure potassium penicillin gave levels not greatly different from potassium penicillin protected with a high melting fat. All forms when given in 100,000 unit doses after a priming dose of 200,000 units gave satisfactory levels for 3 or more hours.

Oral doses of 25,000 units were ineffective usually in producing appreciable plasma penicillin levels; 50,000 unit doses were also unsatisfactory.

Doses of 100,000 units when preceded by a primary dose of 200,000 units an hour earlier gave levels averaging higher than 0.125 unit per cubic centimeter for the first 2 hours and about 0.06 unit for the next 2 hours. Such levels were comparable with those obtained with intramuscular injections of 20,000 units every 3 hours. Doses of 200,000 units gave perceptible plasma levels even at 6 and 8 hours after the dose, although the levels achieved in the first hours were not significantly higher than the 100,000 units with the 200,000 unit priming doses.

From their findings the authors establish a therapeutic regimen of a primary dose of 200,000 units followed by 100,000 units of orally administered penicillin every 3 hours. This should produce therapeutic results in acute infections comparable to those resulting from the intramuscular dose of penicillin of 20,000 units every 3 hours.

W. FOSTER MONTGOMERY, M.D.

SURGICAL PATHOLOGY AND DIAGNOSIS

Ellis, Frank: Needle Biopsy in the Clinical Diagnosis of Tumors. *Brit. J. Surg.*, 1947, 34: 240.

The author outlines the following indications for needle biopsy: when a tumor lies deep to normal

skin or other tissues, when the possibility exists of the tumor being infected, when a major operation would otherwise be necessary, and when such an operation would not allow of the successful extirpation of the tumor, when the usual methods of obtaining histological evidence are contraindicated, and when excision of a lymphnode is contemplated in a suspected case of Hodgkin's disease, needle biopsy may exclude cancer and may establish a diagnosis of Hodgkin's disease.

In 280 cases aspiration biopsies were carried out from the regional lymph glands, and in 87 cases from bones. The aspiration biopsy gave, on the average, about 63 per cent of useful results. In general, the type of case subjected to needle biopsy is one in which, because of lack of bed accommodation, lack of time, or lack of adequate indication in the view of the clinician concerned, a biopsy would not be taken in the ordinary way. In other words, much of the evidence provided for the pathologist by needle biopsies would not be available at all if they were not done.

A drill type of biopsy is advocated for the following types of lesions:

1. Relatively superficial soft-tissue lesions. These include cervical, axillary, inguinal, and other lymph nodes, breast lesions, muscle lesions, and lesions in such situations as the thyroid gland, parotid, or other salivary glands, and the orbit.

2. Easily accessible bony lesions. These include lesions in all the bones except the vertebrae. The bone is inspected and carefully measured on the radiographs to determine the site of entry to be attempted by the drill, aiming at an active part of the pathological process, and ease of approach.

3. The vertebrae. Obvious precautions are taken to avoid the vertebral artery in the cervical portion, the spinal cord, and nerve roots. The dorsal and lumbar vertebrae are more difficult. The neural arches are easily accessible but not often affected. The bodies are deeply situated. From lateral radiographs taken with a marker on the skin in the midline, the depth (6 to 8 cm. usually) of the lesion from the skin can be measured. If the drill is then inserted through the skin at an equal distance from the midline at an angle of 45 degrees to the vertical with the patient lying prone, it is not difficult to strike the lesion. This procedure is best carried out under light general anesthesia and with facilities for radiographic verification of the position of the drill. Pentothal is adequate with premedication and efficient radiography. A grid used on the back for an anteroposterior radiograph with the patient supine is of aid in deciding the level at which to insert the drill through the skin.

4. Intrathoracic lesions. In a radiograph, the ribs form adequate markers for the chest, and by drawing lines from front to back it is possible to determine the direction in which the drill should be passed to the lesion.

5. Prostatic lesions. These are best dealt with in the lithotomy position. It is necessary to have the left index finger in the rectum. The needle is inserted through a small stab in the skin of the perineum, with the patient anesthetized (preferably a general anesthetic). The needle is easily felt, and can be guided into the prostate. The trocar is then removed and drilling commenced.

The author discusses at length the technique used in aspiration biopsy and drill biopsy. A review of the histological technique is also given. Many photographs showing the histological specimens from various locations are shown, which indicate the efficacy of these procedures.

The advantages of drill biopsy over aspiration biopsy are as follows:

1. The operator has greater control, not having to apply suction at the time of introducing the needle.

2. A larger piece of tissue is obtained, which enables the pathologist to give a greater number of positive reports.

Both procedures may be carried out quickly, although the drill biopsy requires a more specialized apparatus. C. FRED GOERINGER, M.D.